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SIRENS IN THE DEEP: A CRITICAL JUNCTURE FOR SEABED MINING

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Abstract

Deep-sea mining is a critical issue for all who depend on the ocean. The extraction of metals from the seabed is framed as necessary for energy and defense technologies, and as a lucrative opportunity for Pacific small island developing states. In reality, deep-sea mining comes with significant economic, environmental, and social risks. The deep sea is one of the least explored and least understood places on earth. Commercial mining risks tearing open the seabed before there is a baseline understanding of what will be destroyed.

This project comes at an important juncture. The International Seabed Authority is set to deliver rules on deep-sea mining later this year, but some states are hastening to begin unilaterally mining the international seabed before those regulations are released, essentially moving forward without a rulebook. This would set a dangerous precedent not only for ocean governance, but for adherence to the international legal order in an increasingly contested world.

This work aims to assist French Polynesia in preventing a tragedy of the commons in the Pacific Ocean, while supporting sustainable economic development on its path to independence. The report brings a multidisciplinary lens to these challenges, drawing on legal and policy research to address the economic, environmental, and social risks of deep-sea mining. The analysis includes a critical assessment of the unique legal issues posed by deep-sea mining, the role of deep-sea minerals in the clean energy transition, and a review of scientific research to-date.

Introduction

The Pacific is at a crossroads. Deep-sea mining, the extraction of minerals from the seabed, is an emerging industry that is poised to disrupt and reshape the geopolitics of the region and the way of life for Pacific states that call the ocean home. While mining the seabed has been discussed for decades, the industry is closer to becoming a reality with advancements in technology and permits for exploration. Deep-sea mining has its sights set on the Pacific, where large clusters of minerals are concentrated. The Clarion-Clipperton Zone, a fracture zone south of Hawai'i that stretches 4,500 miles across the seabed and supports enormous biodiversity, is of particular interest to the industry. At this stage, very little is known about the potential impacts of deep-sea mining.

Yet, deep-sea mining is now closer than ever to commercial exploitation. The International Seabed Authority (ISA) has granted over 30 exploration contracts, many in the Clarion-Clipperton Zone. While the ISA has yet to finalize its regulations for exploitation, some companies and states have expressed their intention to move forward even in the absence of a comprehensive regulatory framework. This would set a dangerous precedent not only for ocean governance, but for adherence to the international legal order in an increasingly contested world. On April 24, 2025, the U.S. Government announced a change in policy through an executive order expediting commercial permits in international and U.S. territorial waters. It is not possible to address this late development in this report; however, we recommend that the implications of this development are further considered.

French Polynesia is among the nations most likely to be affected by the potential harmful consequences of deep-sea mining. With the largest Exclusive Economic Zone (EEZ) in the Pacific, it is also a key stakeholder in regional and international discussions on this issue. To date, French Polynesia has urged restraint: its President, Moetai Brotherson, supports a moratorium on the commercial exploitation of the deep seabed. On the other hand, some neighboring countries view deep-sea mining as a fast track to economic development and independence.

"Don't play gods with the cradle of life" - President Moetai Brotherson

This project is intended to provide French Polynesia with a playbook so that they can punch above their weight in the international arena. To this end, this report raises legal and policy questions that may slow down commercial deep-sea mining until there is more information and more consensus.

The **First Chapter** of this report focuses on economic and legal risks of deep-sea mining. Although deep-sea mining is often framed as a promising path for Pacific states to support national development, the practical reality is more uncertain. Economic risks, such as volatile mineral markets, limit the likelihood of meaningful public revenue. At the same time, deep-sea mining raises unresolved legal questions, ranging from labor conditions to unclear liability for environmental harm. Sponsoring states also face the risk of costly investment disputes. Together, these factors cast serious doubt on whether the potential returns from deep-sea mining justify the broader economic and social costs.

The **Second Chapter** looks at the environmental risks of deep-sea mining. Despite claims that it would be a cleaner alternative to terrestrial mining, growing scientific evidence challenges this narrative. Potential harms from commercial mining activities include habitat destruction, biodiversity loss, and threats to food security and human health. These risks are compounded by persistent knowledge gaps. What is increasingly clear, however, is that deep-sea mining will likely cause lasting environmental, cultural, and human rights harms. For French Polynesia and other stakeholders, the combination of likely harm and limited scientific understanding call for a precautionary, science-based approach rather than a rush toward exploitation.

The **Third Chapter** addresses the claim that mining the seabed is imperative to meet the rising global demand for critical minerals essential to energy and defense technologies. However, current evidence suggests that deep-sea extraction is not necessary to meet this demand. Short-term forecasts for key minerals found in polymetallic nodules have slowed, while viable alternatives, such as land-based sources, recycling, and supply chain innovation, remain available. Considering the significant environmental, economic, and human risks associated with deep-sea mining, there is no evident justification to proceed with exploitation in the near-term. French Polynesia should prioritize innovation in supply chains and recycling infrastructure.

> **“We do not need [...] people telling us only what not to do. We need people with skills and talent to help us, and work with us, in building a sustainable economy.”**
> - President Moetai Brotherson

Chapter 1. Economic and Legal Risks

Deep-sea mining is increasingly framed as a strategic opportunity for Pacific Island nations to generate new revenue streams.[1] Praised by proponents as a lucrative solution to global demand-supply gaps for critical minerals, the reality is far more complex.

This chapter focuses on the economic and legal risks of deep-sea mining. The first part of the chapter shows that multiple economic variables reduce the likelihood of substantial public revenue from this industry, including volatile mineral markets, uncertain fiscal returns, and the distinctive legal regime applicable to commercial profits in international waters. In addition to these economic uncertainties, a meaningful assessment of deep-sea mining's benefits must account for the serious legal risks posed by commercial exploitation. The second part of this chapter focuses on some of these risks, including unclear liability for environmental and other harms, weak transparency and accountability within the relevant international authority, concerns over labor conditions, and potential financial exposure arising from investor-state disputes.

Overall, these risks undermine the economic development narrative, challenging whether deep-sea mining can bring Pacific Island nations equitable economic benefits without exposing them to significant legal and financial uncertainty.

1.1 Economic Risks of Deep Sea Mining

The prospect of harnessing deep-sea minerals to finance critical nation-building initiatives is understandably appealing for Pacific countries, especially for those confronting limited fiscal space. However, beneath the surface of this optimistic narrative lies a far more sobering economic reality: one marked by volatility, low returns, and geo-economic dependencies.

The question facing Pacific governments is not simply whether deep-sea mining can generate revenue, but whether those revenues can ever justify the economic, environmental, and social costs. This section interrogates that proposition by examining the key economic risks of deep-sea mining and the uncertainties they pose for Pacific decision-makers.

[1] Ilya Epikhin, Carlo Stella, Amer Hage Chahine, et al., "Seabed mining: A $20 trillion opportunity", August 2024, https://www.adlittle.com/en/insights/viewpoints/seabed-mining-20-trillion-opportunity.

Market Volatility and Price Risks

Minerals from the deep sea, such as nickel, cobalt, and copper, are traded in global commodity markets. These markets are inherently volatile. Prices move quickly and often without warning. Over the past decade, prices for critical minerals have spiked and plummeted.[2] After a dramatic run up in 2021 and 2022, when lithium prices soared to eight times their previous levels, 2023 marked a sharp reversal. Since then, lithium prices have plunged by over 80 percent, while other minerals like nickel, cobalt, and graphite have seen their prices drop by roughly 50 percent.[3]

Drivers of Volatility

Fluctuations in critical mineral markets are typically driven by shifts in demand- and supply-side dynamics, and increasingly, geopolitical influences. On the demand side, macroeconomic conditions affect consumer spending on mineral-intensive goods, and influence the pace of industrial activity. Currently, the demand-side growth for critical minerals remains dominated by clean energy technologies, particularly electric vehicle development.[4] Emerging trends, such as technical innovation and recycling, offer potential to moderate market volatility in the medium term, though their influence remains limited in the near term (see **Chapter 3.3**: Energy Transition).[5] On the supply side, factors such as low-cost production and state-led oversupply can suppress global prices. In recent years, a rapid expansion of supply from Africa, Indonesia, and China, has significantly outpaced global demand growth, and contributed to market imbalances.[6]

Geopolitical interventions, such as export restrictions, stockpiling, and trade barriers, are increasingly being used to influence global critical mineral prices. The larger a country's share in the critical mineral supply chain, the greater their ability to wield that position as a geopolitical weapon.

China exemplifies this geopolitical dynamic by dominating global minerals refining (68% of nickel, 40% of copper, 59% of lithium, and 73% of cobalt) and production (70% of cathodes, 85% of anodes, 66% of separated and 62% of electrolytes for batteries).[7]

Between 2023 and 2025, China imposed export restrictions of strategic materials such as gallium, germanium, and graphite to the United States.[8] And more recently, China put

[2] Gracelin Baskaran, "Drivers of Base Metals Price Volatility", June 2024, CSIS, https://www.csis.org/analysis/drivers-base-metals-price-volatility.
[3] Shobhan Dhir, Eric Buisson, Tae-Yoon Kim, "Growing geopolitical tensions underscore the need for stronger action on critical minerals security", International Energy Agency, February 2025, https://www.iea.org/commentaries/growing-geopolitical-tensions-underscore-the-need-for-stronger-action-on-critical-minerals-security.
[4] IEA, "Critical Minerals Outlook", 2024, https://iea.blob.core.windows.net/assets/ee01701d-1d5c-4ba8-9df6-abeeac9de99a/GlobalCriticalMineralsOutlook2024.pdf.
[5] IEA "Recycling of Critical Minerals", 2024, https://www.iea.org/reports/recycling-of-critical-minerals/executive-summary
[6] IEA, "Critical Minerals Outlook", 2024, https://iea.blob.core.windows.net/assets/ee01701d-1d5c-4ba8-9df6-abeeac9de99a/GlobalCriticalMineralsOutlook2024.pdf
[7] Rodrigo Castillo, "China's role in supplying critical minerals for the global energy transition: What could the future hold?", August 2022, https://www.brookings.edu/articles/chinas-role-in-supplying-critical-minerals-for-the-global-energy-transition-what-could-the-future-hold/.
[8] Gracelin Baskaran and Meredith Schwartz, "The Consequences of China's New Rare Earths Export Restrictions", April 2025, CSIS, https://www.csis.org/analysis/consequences-chinas-new-rare-earths-export-restrictions#:~:text=China%20first%20weaponized%20rare%20earths,antimony%2C%20graphite%2C%20and%20tungsten.

restrictions on seven rare earth elements and magnets as a retaliatory response to the tariffs imposed by the United States.[9] As the trade conflict between these two countries continues to accelerate, countries can be expected to continue leveraging their positions in the critical mineral supply chain to their advantage.[10] Critical minerals markets are likely to become more volatile as a result.

Risks of Market Volatility in the Pacific

Pacific Island countries are particularly vulnerable to global commodity price swings due to their narrow economic bases, heavy reliance on imports, and exposure to exchange rate volatility.[11] Price swings in the minerals and metals markets could be devastating for small economies already highly exposed to other external risks. These include, but are not limited to: falling global growth, geopolitical tensions, slowdowns in major economies, tighter global financial conditions, the fragmentation of trade and investment networks, and increased outmigration.[12]

Climate change-related disasters further compound these risks. For example, the cost of natural disaster occurrences in Vanuatu has been around 60 percent of its gross domestic product (GDP). Similar to global recessions, natural disasters cause lasting damage to fiscal health in small states, weaken government budget balances, and drive up debt levels relative to GDP.[13] Taken together, introducing another commodity upon which national economies would rely significantly increases exposure to market volatility, reducing overall economic resilience.

These price swings pose serious risks for pacific countries considering deep-sea mining as a national revenue stream. Like oil and gas, deep-sea mining operations are only commercially

[9] Gracelin Baskaran and Meredith Schwartz, "The Consequences of China's New Rare Earths Export Restrictions", April 2025, CSIS, https://www.csis.org/analysis/consequences-chinas-new-rare-earths-export-restrictions#:~:text=China%20first%20weaponized%20rare%20earths,antimony%2C%20graphite%2C%20and%20tungsten.

[10] Shobhan Dhir, Eric Buisson, Tae-Yoon Kim, "Growing geopolitical tensions underscore the need for stronger action on critical minerals security", International Energy Agency, February 2025, https://www.iea.org/commentaries/growing-geopolitical-tensions-underscore-the-need-for-stronger-action-on-critical-minerals-security.

[11] Hoe Ee Khor, Roger P. Kronenberg, and Patrizia Tumbarello, "Resilience and Growth in the Small States of the Pacific", August 2016, International Monetary Fund, https://www.imf.org/en/Publications/Books/Issues/2017/03/24/Resilience-and-Growth-in-the-Small-States-of-the-Pacific-42684.

[12] The World Bank, "Pacific Economic Update: Diminishing Growth amid Global Uncertainty: Ramping up Investment in the Pacific", 2024, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099101424002525333/p5069571930b360dd1a998151821271584d.

[13] The World Bank, "Pacific Economic Update: Diminishing Growth amid Global Uncertainty: Ramping up Investment in the Pacific", 2024, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099101424002525333/p5069571930b360dd1a998151821271584d.

viable above certain price points. If mineral prices drop below these levels, anticipated revenues can evaporate, and undermine the entire economic case for investment. Moreover, the high upfront costs of infrastructure and regulatory development could quickly turn into stranded assets. For Pacific Island countries with limited fiscal buffers and already high debt burdens,[14] anchoring future growth to such a volatile market is not only risky, but fiscally imprudent. There is also the risk of Pacific countries undercutting themselves. If several states pursue deep-sea mining into the 2030s, this could lead to oversupply, flooding global markets, and potentially triggering a price collapse.[15] In such a scenario, mining companies may cut costs to remain competitive by weakening environmental and labor protections.

Across the Pacific, there are several cautionary tales that highlight the economic risks of commodity dependence. One of the starkest examples is Nauru:

In the 1970s and early 1980s, **Nauru** was briefly among the richest countries per capita in the world, driven almost entirely by phosphate mining revenues.[16] However, the country's extreme reliance on a single commodity exposed it to major economic vulnerabilities.[17] By the 1990s, phosphate reserves had been depleted and global prices fell. Mismanagement of the wealth fund and lack of economic diversification compounded the crisis, and Nauru's economy collapsed. Public services deteriorated, unemployment soared, and the government incurred unsustainable levels of debt.[18] Nauru's experience underscores the macroeconomic hazards of commodity booms in small, undiversified economies.

As seen in Nauru, over reliance on deep-sea mining revenues could risk economic collapse if prices suddenly fall or operational costs rise unexpectedly.

Country-Level Economic and Financial Risks

Fiscal Returns: More Risk Than Reward

Pacific countries are unlikely to derive substantial fiscal benefits from deep-sea mining in international waters.[19] Under the governance of the International Seabed Authority (ISA), royalties from mining activities in "the Area" are to be shared among all member states.[20] The

[14] The World Bank, "Pacific Economic Update: Diminishing Growth amid Global Uncertainty: Ramping up Investment in the Pacific", 2024, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099101424002525333/p5069571930b360dd1a998151821271584d.
[15] Emma Amadi and François Mosnier, "Mining for Trouble, Planet Tracker", https://planet-tracker.org/wp-content/uploads/2024/11/Mining-for-Trouble.pdf.
[16] Nancy Pollock, "Nauru Phosphate History and the Resource Curse Narrative", Journal de la Société des Oceanistese, 2014, https://nauru-data.sprep.org/resource/nauru-phosphate-history-and-resource-curse-narrative.
[17] Nancy Pollock, "Nauru Phosphate History and the Resource Curse Narrative", Journal de la Société des Oceanistese, 2014, https://nauru-data.sprep.org/resource/nauru-phosphate-history-and-resource-curse-narrative.
[18] Nancy Pollock, "Nauru Phosphate History and the Resource Curse Narrative", Journal de la Société des Oceanistese, 2014, https://nauru-data.sprep.org/resource/nauru-phosphate-history-and-resource-curse-narrative.
[19] Daniel Wilde, Hannah Lily, Neil Craik, and Anindita Chakraborty, "Equitable sharing of deep-sea mining benefits: More questions than answers", March 2023, Marine Policy, https://www.sciencedirect.com/science/article/pii/S0308597X23000994#sec0015.
[20] ISA, "Equitable sharing of financial and other benefits from deep-sea mining", 2021, https://www.isa.org.jm/wp-content/uploads/2022/06/ISA_Technical_Study_31.pdf.

legal framework established under the United Nations Convention on the Law of the Sea (UNCLOS) supports a distributive mechanism based on principles of sovereign equality and distributive justice.[21] This global pooling of revenues could limit the financial upside for individual states, especially small economies in the Pacific.

A recent report by the Massachusetts Institute of Technology (MIT), commissioned by the ISA, modeled two potential approaches to revenue sharing: one based on equal per capita distribution, and the other on income redistribution. In both scenarios, the projected financial returns for most countries, including Pacific Island states, are minimal.[22] These projections are based on assumed outputs from two polymetallic nodule mining operations. According to the MIT model, total distributable revenues from these operations are expected to be approximately $14 million annually in the medium term (2028-2030), rising to $228 million annually in the long term (2036-2056), after deducting ISA administrative costs.[23] Under either an equal distribution or a population-weighted model, fiscal returns for Pacific Island countries remain negligible. For example, under the income redistribution scenario, Kiribati would be set to receive between $7,528 and $199,841 annually in the long term, just 0.034% of its gross national income.[24] Niue's estimated returns range from $5 to $6,806 annually. These figures underscore the limited fiscal value of deep-sea mining in the Area for Pacific states.[25]

Similarly, domestic deep-sea mining within Exclusive Economic Zones (EEZs) is unlikely to generate significant public revenue. Several factors contribute to this:

- **First**, weak fiscal regimes and investor-friendly contracts often lead to low tax and royalty revenues. Countries seeking to attract foreign direct investment may offer reduced tax rates, and create a race to the bottom dynamic across the Pacific region that ultimately reduces public fiscal benefits.[26]

- **Second**, mining companies may structure their operations through offshore subsidiaries, and potentially avoid corporate taxation obligations in sponsoring states.

- **Third**, the potential liability costs at the national level, such as those arising from environmental damage, are often underestimated or excluded from economic projections. For example, the Pacific Community's (SPC) 2016 cost-benefit analysis valued the clean-up cost following an unplanned spill at merely $34,000 and assigned zero

[21] Daniel Wilde, Hannah Lily, Neil Craik, Anindita Chakraborty, "Equitable sharing of deep-sea mining benefits: More questions than answers", March 2023, Marine Policy, https://www.sciencedirect.com/science/article/pii/S0308597X23000994#sec0015.
[22] Daniel Wilde, Hannah Lily, Neil Craik, Anindita Chakraborty, "Equitable sharing of deep-sea mining benefits: More questions than answers", March 2023, Marine Policy, https://www.sciencedirect.com/science/article/pii/S0308597X23000994#sec0015.
[23] Daniel Wilde, Hannah Lily, Neil Craik, Anindita Chakraborty, "Equitable sharing of deep-sea mining benefits: More questions than answers", March 2023, Marine Policy, https://www.sciencedirect.com/science/article/pii/S0308597X23000994#sec0015.
[24] Daniel Wilde, Hannah Lily, Neil Craik, Anindita Chakraborty, "Equitable sharing of deep-sea mining benefits: More questions than answers", March 2023, Marine Policy, https://www.sciencedirect.com/science/article/pii/S0308597X23000994#sec0015.
[25] Daniel Wilde, Hannah Lily, Neil Craik, Anindita Chakraborty, "Equitable sharing of deep-sea mining benefits: More questions than answers", March 2023, Marine Policy, https://www.sciencedirect.com/science/article/pii/S0308597X23000994#sec0015.
[26] Peter Mullins and Lee Burns, "The fiscal regime for deep sea mining in the Pacific region", September 2018, Marine Policy, https://www.sciencedirect.com/science/article/pii/S0308597X16304808.

economic value to the ecosystem services of deep-sea vents.[27] These valuations represent significant undervaluation of environmental and non-market costs.

- **Fourth**, capital investments by states to attract investment may contain risks of significant financial loss.

Case Study: Papua New Guinea

The case of Papua New Guinea's (PNG) Solwara 1 project exemplifies these risks. The project, led by Canadian company Nautilus Minerals Ltd., was among the first commercial deep-sea mining ventures. In 2011, the Papua New Guinean government acquired a 30% equity stake in the project, investing $120 million.[28] Nautilus failed to raise sufficient capital, defaulted on payments, and lost its final investor in 2018.[29] The company entered liquidation in 2019 and PNG lost the entirety of its public investment. A Canadian court later ruled that PNG was an equity partner, not a creditor, and therefore precluded any recovery of funds.[30] The Solwara 1 experience illustrates the speculative nature of deep-sea mining, and the risks of significant public financial losses.

Economic Trade-offs and the Risk of Dutch Disease

For countries with limited fiscal capacity, participation in deep-sea mining often requires substantial public investment. This may involve funding for enabling infrastructure, regulatory frameworks, and even direct equity stakes in mining projects. These investments divert scarce resources away from essential development priorities, including healthcare, education, and climate resilience. Moreover the costs of regulatory oversight and enforcement fall on governments, not mining companies, and require sustained technical capacity. The prospect of windfall mining revenues may also distort policy priorities. Governments may defer investment in long-term development sectors, in favour of perceived short-term gains. This undermines economic resilience and sustainable development priorities that are vital for Pacific countries.

Deep-sea mining can also weaken other sectors of the economy. A surge in resource revenues can appreciate the real exchange rate, and make other exports less competitive. This is known as the "Dutch Disease" effect. In the Pacific, this could hurt fisheries and sustainable tourism, especially given their resilience of stable prices and a clean natural environment. Mining projects can also redirect labor and capital from key sectors, with the promise of higher wages shifting

[27] SPC, "An Assessment of the Costs and Benefits of Mining Deep-sea Minerals in the Pacific Island Region: deep-sea Mining Cost-Benefit Analysis", 2016, https://www.sprep.org/attachments/VirLib/Regional/deep-sea-mining-cba-PICs-2016.pdf
[28] E.I. van Putten, S. Aswani, W.J. Boonstra, R. De la Cruz-Modino, J. Das, M. Glaser, N. Heck, S. Narayan, A. Paytan, S. Selim & R. Vave, "History matters: societal acceptance of deep-sea mining and incipient conflicts in Papua New Guinea", 2023, Nature, https://link.springer.com/article/10.1007/s40152-023-00318-0
[29] Colin Filer, Mathew Allen, Jennifer Gabriel, "How PNG lost US$120 million and the future of deep-sea mining", Dev Policy Blog, April 2020, https://devpolicy.org/how-png-lost-us120-million-and-the-future-of-deep-sea-mining-20200428/
[30] Colin Filer, Mathew Allen, Jennifer Gabriel, "How PNG lost US$120 million and the future of deep-sea mining", Dev Policy Blog, April 2020, https://devpolicy.org/how-png-lost-us120-million-and-the-future-of-deep-sea-mining-20200428/

workers away from more sustainable livelihood generation. Overtime, this weakens economic diversity.

The Problem with Cost Benefit Analyses in Deep-Sea Mining

Conventional cost-benefit analysis (CBA) methodologies often fail to capture the profound uncertainties inherent in deep-sea mining. This limitation is evident in the SPC's 2016 economic analysis, which employed a static model that was poorly equipped to address technical uncertainties (e.g., production volumes and operational reliability), financial uncertainties (e.g., mineral price volatility), and ecological uncertainties (e.g., irreversible environmental damage).[31] For instance, the SPC study did not consider the financial fragility of mining firms: whether the value of the mining contract comprises a significant portion of their portfolio, or whether it made up a small portion of a larger diversified portfolio. Nor did it consider the dependence of small states on the success of singular ventures, as seen with the failed Solwara 1 project in PNG.

Furthermore, CBAs often lack clarity regarding the stakeholder perspective from which assumptions are made. Private firms, governments, and local communities apply different discount rates and risk tolerances.[32] The 2016 SPC study analysis monetised environmental values using willingness to pay and ecosystem service replacement methods, by drawing analogies from terrestrial mining to estimate the value of ecosystem losses. This methodological transfer to deep-sea environments undermines the validity of the conclusions, and disregards ecological value. Additionally, the analysis failed to account for cumulative and transboundary environmental impacts.

Given these limitations, deep-sea mining decisions should adopt decision-making frameworks better suited to uncertainty and the possibility of irreversibility. Approaches like "real options analysis", "robust decision making", and the precautionary principle provide more resilience for bases for policy.[33] These methods allow decision makers to consider a broader range of plausible futures, which is particularly critical in

[31] Kerry Krutilla, David Good, Michael Toman, et al., "Addressing Fundamental Uncertainty in Benefit-Cost Analysis: The Case of Deep Seabed Mining", Journal of Benefit-Cost Analysis, February 2021 https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/addressing-fundamental-uncertainty-in-benefitcost-analysis-the-case-of-deep-seabed-mining/75801881799BD7EB2D3CF7B33C4DDAC6.

[32] Kerry Krutilla, David Good, Michael Toman, et al., "Addressing Fundamental Uncertainty in Benefit-Cost Analysis: The Case of Deep Seabed Mining", Journal of Benefit-Cost Analysis, February 2021 https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/addressing-fundamental-uncertainty-in-benefitcost-analysis-the-case-of-deep-seabed-mining/75801881799BD7EB2D3CF7B33C4DDAC6.

[33] Kerry Krutilla, David Good, Michael Toman, et al., "Addressing Fundamental Uncertainty in Benefit-Cost Analysis: The Case of Deep Seabed Mining", Journal of Benefit-Cost Analysis, February 2021 https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/addressing-fundamental-uncertainty-in-benefitcost-analysis-the-case-of-deep-seabed-mining/75801881799BD7EB2D3CF7B33C4DDAC6.

managing shared ocean commissions with high ecological stakes, and limited empirical knowledge.

1.2 Legal Risks of Deep-Sea Mining

In addition to the economic risks outlined above, deep-sea mining presents significant legal risks and potential sources of liability. These risks stem from the specific and unique nature of deep-sea mining as an industry and flow from the substantial uncertainties about the deep seabed, how large-scale exploitation operations activities might occur, and how these activities may impact the seabed.

The central goal of regulating mining operations and industries is the allocation of burdens, risks and benefits between stakeholders in a project, whether financially, or as stakeholders who benefit from and have a connection to the environment. In a context of ongoing scientific uncertainty, many of the risks involved are unquantifiable with any degree of specificity. This creates significant challenges to ensuring that risks, burdens and liabilities are allocated appropriately, and substantially increases the danger that these will fall on governments, citizens, and other stakeholders who inhabit and live in connection with the environment.

This chapter will map some of the legal risks arising from gaps in existing regimes that allocate responsibility for environmental harms. It will also examine structural integrity and transparency concerns within the ISA. Finally, this chapter will outline some of the specific challenges concerning labor rights that could affect workers protections in deep-sea mining, and highlight the potential financial liability associated with disputes under international investment law.

The Shortcomings of Existing Liability Regimes

Given deep-sea mining's invasive nature and the state of today's technology, an inevitable question arises: what happens if something goes wrong? After "what happens if something goes wrong", another question follows: who is responsible for what went wrong?

Liability generally refers to an individual's or an entity's legal responsibility for their actions or inaction. It is one of deep-sea mining's central legal questions given the potential for significant environmental and other harms. Different liability regimes may apply depending on whether mining occurs in international waters or within a state's Exclusive Economic Zone (EEZ), potentially triggering both international and domestic legal frameworks. This section reviews the relevant liability regimes under international and domestic law and concludes that serious gaps remain, casting doubt on whether current frameworks can hold deep-sea mining actors accountable for potential harms.

The ISA Liability Regime

This section starts by examining the International Seabed Authority's (ISA) regime, before turning to its role in addressing transboundary harm.

Overview of the ISA Regime

The main international legal instrument applicable to deep-sea mining is the United Nations Convention on the Law of the Sea (UNCLOS), a framework convention that came into force in 1994.[34] As of writing, 170 States have ratified it, including France. The United States has not. UNCLOS establishes a comprehensive legal framework governing the oceans and the use of marine resources. It also established the ISA, granting it powers to "organize and control activities in the Area", and to administer the Area's resources.[35]

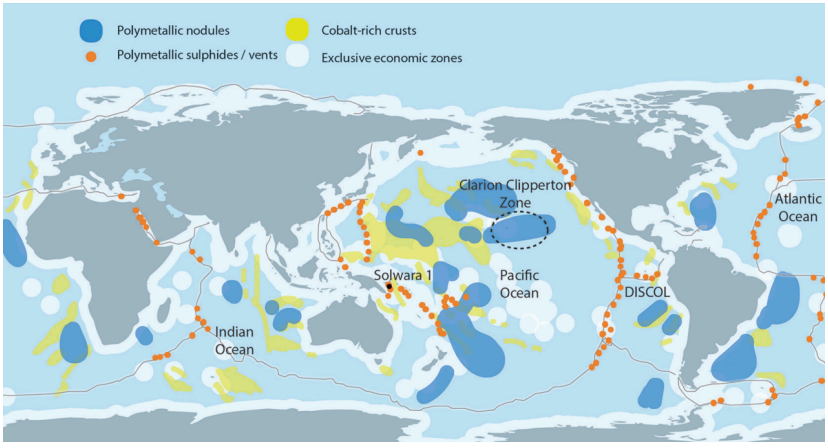
What is the "Area"?

The Area is defined as the "seabed and ocean floor and subsoil thereof beyond the limits of national jurisdiction" (See UNCLOS at art. 1).

UNCLOS governs all activities connected with exploration and exploitation of mineral resources in the Area.

UNCLOS designates the Area and its resources as the "common heritage of mankind",[36] such that no "State shall claim or exercise sovereignty or sovereign rights over any part of the Area or its resources, nor shall any State or natural or judicial person appropriate any part thereof", and all "rights in the resources of the Area are vested in mankind as a whole."[37] As a common heritage of mankind, these resources "belong to all of humanity, both present and future."[38]

The ISA is in charge of organizing, carrying out and controlling activities in the Area, on behalf of mankind as a whole,[39] while ensuring the effective protection of the marine environment.[40] Pursuant to article 153 of UNCLOS, the ISA has the power to confer exclusive rights to states or private companies to use part of the



[34] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994).
[35] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 156, 157.
[36] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 136.
[37] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 137.
[38] Riley Traut, "Stuck Between a Polymetallic Nodule and a Hard Place: Harmonizing Deep-Sea Mineral Exploitation and Prevention of Harm to the Marine Environment Under the United Nations Convention on the Law of the Sea," *Columbia Journal of Transnational Law*, 2024, 164–164.
[39] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 140, 153.
[40] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 145.

Area. To exercise exclusive rights in relation to a part of the Area, a state or company must submit and obtain ISA approval for a specific work plan. Once approved, the recipient has contract exclusive rights to use that area for the plan's purposes.

The ISA is responsible for setting out rules, regulations and procedures governing activities in the Area,[41] including deep-sea mining. Such rulemaking concerns, among other things:

> (a) the prevention, reduction and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment, particular attention being paid to the need for protection from harmful effects of such activities as drilling, dredging, excavation, disposal of waste, construction and operation or maintenance of installations, pipelines and other devices related to such activities;
>
> (b) the protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment."[42]

It is important to note that Nauru is currently attempting to short circuit the ISA rulemaking process for deep-sea mining. In fact, the country announced its intention to submit a work plan for commercial exploitation of the deep seabed to the ISA in June 2025. Nauru claims that its triggering of the so-called "two year rule" on July 9, 2021, meant that the ISA was required to make its best efforts to complete the adoption of the relevant rules, regulations and procedures for commercial exploitation by July 9, 2023. Given that the ISA has yet to finalize the relevant regulatory framework, Nauru argues that the ISA is now required to give provisional approval to any submitted work plan.[43] As discussed in last year's Capstone report, there are strong legal arguments that Nauru's legal interpretation is incorrect:

> "In this case, the two-year deadline that was triggered by Nauru's request expired on June 25, 2023. Thus, the ISA must abide by its obligation under Section 1(15)(c). Nevertheless, the scope of the obligations that the ISA has under that section of UNCLOS depend[s] on whether it is textually or teleologically interpreted. While a textual reading would force the ISA to approve Nauru's work plan, a teleological interpretation would solely oblige the ISA to consider the overall object and purpose of the Agreement. This section explains that a teleological interpretation would be favorable to French Polynesia as the ISA would not have to immediately and provisionally approve Nauru's work plan."[44]

[41] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 145.
[42] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 145.
[43] David Aingimea to Olav Myklebust, "Addition of Agenda Item to the March 2025 Council Agenda: Process for Consideration of Applications for Plans of Work for Exploration in the Absence of Adopted Exploitation Regulations," November 12, 2024, https://www.isa.org.jm/wp-content/uploads/2024/11/Nauru-Letter-to-ISA-Council-President-re-Process-for-Plan-of-Work_10112024.pdf.
[44] Jenik Radon et al., rep., *Murkier Waters — The Challenge and Risks of Deep-Sea Mining "Development,"* 2024, 56-56.

Contractor Liability under the ISA Regime

When an entity seeks to explore and exploit the Area's seabed, the ISA mandates contractual agreements with these entities. These contracts are sponsored by UNCLOS state parties and must comply with the ISA's regulatory framework.[45]

By way of background, regulatory regimes in the mining context often distinguish between "exploration" and "exploitation" phases. Exploration phases are smaller scale and often governed by more permissive regimes intended to enable testing, verification of the location, viability of the resource, and proof of production methods. Exploitation regimes are more onerous because they govern full-scale operations, often over a much larger area, and with more significant impacts.

The ISA's regulatory framework pertaining to exploration was finalized in 2013 and, as of January 31, 2023, the ISA has issued 31 exploration contracts.[46] To this end, it approved a set of Standard Clauses common to all exploration contracts. These clauses outline the contractors' liability and responsibility:

> "The Contractor shall be liable for the actual amount of any damage, including damage to the marine environment, arising out of its wrongful acts or omissions, and those of its employees, subcontractors, agents and all persons engaged in working or acting for them in the conduct of its operations under this contract, including the costs of reasonable measures to prevent or limit damage to the marine environment, account being taken of any contributory acts or omissions by the Authority."[47]

These mining contracts thus seem to provide a first possibility for (contractual) liability. However, these clauses contain significant gaps, as highlighted in the 2024 Capstone Report:

> "The wording of this clause lacks air-tight precision. The contractors' liability in cases of damage remains vague. The present Responsibility and Liability Clause fails to fully address contractors' strict responsibility for all direct and indirect injury, damage, as well as legal and other expenses incurred by any party, including distant parties affected by ocean currents and ongoing movement, and potential harm to sea life. Additionally, the Clause is devoid of any provision allocating the burden of proof regarding the damage and its cause."[48]

Furthermore, the Standard Clauses for these contracts fail to include Restoration Clauses under which a contractor would be contractually obligated to restore any impaired, damaged or

[45] Jenik Radon et al., rep., *Murkier Waters — The Challenge and Risks of Deep-Sea Mining "Development,"* 2024, 67.
[46] Riley Traut, "Stuck Between a Polymetallic Nodule and a Hard Place: Harmonizing Deep-Sea Mineral Exploitation and Prevention of Harm to the Marine Environment Under the United Nations Convention on the Law of the Sea," *Columbia Journal of Transnational Law*, 2024, 174-174.
[47] ISA Contract for Exploration – Public Information Template, accessed April 23, 2025, https://www.isa.org.jm/wp-content/uploads/2022/10/Public-information-on-contracts-COMRA_CFC.pdf.
[48] Jenik Radon et al., rep., *Murkier Waters — The Challenge and Risks of Deep-Sea Mining "Development,"* 2024, 68-69.

destroyed ecosystem.[49] As underscored by the 2024 Capstone Report, "a review of publicly available contracts for deep seabed mineral exploration reveals that none of them contain a Restoration Clause in the event of environmental damage."[50] It is likely that exploration contracts that have not been made publicly available also lack such provisions.[51] Additionally, the Standard Clauses for exploitation contracts, expected to serve as templates for future commercial exploitation ventures, fail to address this issue.

Consequently, no contractual restoration obligation is imposed under the ISA regime on mining companies in the event of environmental damage. This type of provision is crucial in the context of deep-sea mining given how difficult restoring the seabed might prove to be in practice. Comprehensive obligations on this issue must therefore be included in ISA Standard Clauses or otherwise addressed under the applicable liability regime for commercial exploitation to begin safely.

Beyond the Standard Clauses discussed above, regulations for exploitation activities, referred to as the "Mining Code,"[52] are still being drafted. The 2024 Capstone Report emphasized that the absence of regulation "has created a climate of uncertainty surrounding the applicable legal framework to [the deep-sea mining] exploitation phase", and that this lack of exploitation regulations may "transform the landscape of [deep-sea mining] into an arena ripe for complex disputes, as companies that have invested in exploration activities could want recovery if they are permanently prevented from exploiting their findings."[53]

Additionally, the ISA regime minimally engages with corporate liability issues. UNCLOS mentions private "entities" and contractors, but does not specify whether and to what extent the corporate veil shielding corporate owners from responsibility may be pierced. Instead, the question of piercing that veil falls under domestic law, meaning that domestic liability regimes will determine which actors may be held accountable for harms, including whether ultimate beneficial owners of mining companies may be subject to liability. Importantly, domestic regimes do not necessarily hold such actors liable, as will be discussed in greater detail later in this section.

The ISA's current contractual liability framework thus lacks the air-tight precision that would make a contractor liable for any and all environmental damage occurring during mining activities, requiring them to restore any impaired, damaged or destroyed ecosystem.

[49] "Environmental Restoration Program," Naval Facilities Engineering Systems Command, accessed April 22, 2025, https://www.navfac.navy.mil/Divisions/Environmental/Products-and-Services/Environmental-Restoration/#:~:text=Environmental%20restoration%20(also%20known%20as,soils%2C%20fisheries%2C%20nd%20coastlines.
[50] "Exploration Contracts," International Seabed Authority, March 25, 2025, https://www.isa.org.jm/exploration-contracts/.
[51] Jenik Radon et al., rep., *Murkier Waters — The Challenge and Risks of Deep-Sea Mining "Development,"* 2024, 69-69.
[52] "The Mining Code," International Seabed Authority, June 25, 2024, https://www.isa.org.jm/the-mining-code/.
[53] Jenik Radon et al., rep., *Murkier Waters — The Challenge and Risks of Deep-Sea Mining "Development,"* 2024, 69-69.

Sponsoring State Liability under the ISA Regime

Similar to contractors, the ISA does not ensure sufficient Sponsoring State liability. Indeed, UNCLOS requires State Party sponsorship for any entity wishing to conduct activities in the Area.[54] Sponsoring States are subject to a range of obligations under UNCLOS, including the duty to ensure that activities in the Area are conducted in accordance with Part XI of the Convention, which governs the Area. Additionally, Sponsoring States are required to verify that the contractors they sponsor comply with both the provisions of UNCLOS and the terms of their contracts.[55] However, UNCLOS simultaneously weakens the Sponsoring States responsibility by protecting them from liability. As outlined in the breakout box below, the Convention protects states "from liability for contractors' actions":[56]

> "A sponsoring State shall not, however, be liable for damage caused by any failure of a contractor sponsored by it to comply with its obligations if that State Party has adopted laws and regulations and taken administrative measures which are, within the framework of its legal system, reasonably appropriate for securing compliance by persons under its jurisdiction" (See UNCLOS Annex III, art. 4).

While the "intention of this requirement is to ensure that the obligations that bind State Parties are extended to the entities they sponsor," it protects the Sponsoring States from liability as long as measures that are "reasonably appropriate" to secure compliance within their legal system are taken.[57]

The Sponsoring State's obligation is also an obligation "of conduct," not of result. As such, the "State is not obliged to always achieve a specified outcome, provided it does what it is required to do, such as adopt and enforce administrative measures."[58] However, UNCLOS lacks clarity when it comes to what such measures entail. What is a "reasonably appropriate" measure? A Sponsoring State must make its best efforts to fulfil its obligation by adopting national laws, regulations and administrative measures,[59] but there is uncertainty about what is required for the content of these measures and the circumstances in which a measure may be deemed insufficient, thereby triggering State liability.

Given the lack of an internationally agreed standard for complying with a Sponsoring State's due diligence obligations, "if a liability incident were to occur, the state would be subject to uncertainty around both what the diligence standard is, and whether the state had complied with

[54] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), Annex III.
[55] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 139, and Annex III, art. 4.
[56] Riley Traut, "Stuck Between a Polymetallic Nodule and a Hard Place: Harmonizing Deep-Sea Mineral Exploitation and Prevention of Harm to the Marine Environment Under the United Nations Convention on the Law of the Sea," *Columbia Journal of Transnational Law*, 2024, 176-176.
[57] Riley Traut, "Stuck Between a Polymetallic Nodule and a Hard Place: Harmonizing Deep-Sea Mineral Exploitation and Prevention of Harm to the Marine Environment Under the United Nations Convention on the Law of the Sea," *Columbia Journal of Transnational Law*, 2024, 176-176.
[58] "Risky Business: Liability for Deep-Sea Mining Sponsoring States," Deep Sea Conservation Coalition, March 5, 2025, https://deep-sea-conservation.org/resources/risky-business-liability-for-deep-sea-mining-sponsoring-states/.
[59] Talatu Akindolire, "Role and Responsibilities of Sponsoring States in Deep Seabed Mining," in *International Seabed Authority*, 2022, https://www.isa.org.jm/wp-content/uploads/2022/12/1_Talatu_Akindolire_ADSR_Abuja_workshop_Day_2.pdf.

it."[60] These ambiguities show that the ISA has left a "gaping hole in its legal recourse for non compliant contractors or environmental disasters: the ISA does not hold Sponsor States strictly liable for the actions of their sponsored entity."[61]

Dispute Resolution under the ISA Regime

The ISA regime also lacks clarity when it comes to which jurisdictions would be competent to hear claims arising from deep-sea mining activities. Part XV of UNCLOS establishes a dispute resolution system for claims arising under the application and interpretation of the Convention. The Convention first imposes an obligation on State Parties to settle disputes by peaceful means.[62] In the event that a peaceful settlement cannot be reached,[63] the Convention provides that disputes may be heard by the International Tribunal for the Law of the Sea; the International Court of Justice; or arbitral tribunals constituted in accordance with the Convention.[64]

Entities other than State Parties, such as organizations or private entities, may bring a claim to the International Tribunal for the Law of the Sea in a case expressly provided for in Part XI or pursuant to any other agreement conferring jurisdiction to the Tribunal.[65] In this regard, UNCLOS provides that the Seabed Disputes Chamber, a Chamber of the International Tribunal of the Law of the Sea, shall have jurisdiction under article 187 of UNCLOS for claims brought with respect to activities in the Area falling within several categories. These categories include:

- Disputes between States Parties concerning the interpretation or application of UNCLOS;
- Disputes between the ISA and a prospective contractor sponsored by a State; and
- Disputes between parties to a contract, being States Parties, state enterprises and natural or judicial persons concerning: (1) the interpretation or application of a contract, or (2) acts or omissions of a party to the contract relating to activities in the Area and directed to the other party or directly affecting its legitimate interests.

Under this framework, it seems disputes arising out of deep-sea mining contracts would thus be subject to the Seabed Disputes Chamber's jurisdiction. However, does this regime change if the party bringing suit is not a State but is a private entity, an organization, an individual? Would this regime still apply if a party brought a claim under national law rather than UNCLOS? What if the parties tried to designate another jurisdiction? These questions appear unanswered by UNCLOS.

[60] The Ocean Foundation and Bobbi-Jo Dobush, rep., *Deep Seabed Mining (deep-sea mining) Risk and Liability Considerations*, 2023, 10-10.
[61] Riley Traut, "Stuck Between a Polymetallic Nodule and a Hard Place: Harmonizing Deep-Sea Mineral Exploitation and Prevention of Harm to the Marine Environment Under the United Nations Convention on the Law of the Sea," *Columbia Journal of Transnational Law*, 2024, 193-193.
[62] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 279, art. 280.
[63] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 286.
[64] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 287.
[65] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), Annex VI, art. 20.

The ISA Does not Adequately Address the High Risk of Transboundary Harm

Given the nature of deep-sea mining activities and the ocean's currents, effects of deep-sea mining will most likely be felt across boundaries. Environmental harms originating from one jurisdiction may have consequences in another. Such transboundary harm is prohibited under international law by the "No-Harm Principle". Specifically, no State has the right to use or permit use of its territory in a way that will cause injury to the territory or another State, or to properties or persons within that State. UNCLOS also imposes an obligation on States to protect and preserve the marine environment.[66] This includes a duty to prevent pollution within marine environments:

> "States shall take all measures necessary to ensure that activities under their jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment, and that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights in accordance with this Convention."[67]

Beyond the uncertainties related to liability under the ISA regime, another shortcoming is that it does not clearly specify how a State could seek redress for transboundary harm caused by another State sponsoring deep-sea mining within the Area or within its own EEZ. The ISA also does not have the capacity to monitor compliance and ensure enforcement with the UNCLOS obligations set out above.[68] These gaps must be addressed to ensure that commercial exploitation of the deep seabed does not generate transboundary harm without adequate redress available.

Domestic Liability Regimes

French Polynesia is an overseas collectivity of France with a specific autonomous status. The 2004 Organic Law[69] divides subject-matter competences between France and French Polynesia. Under this framework, French Polynesia may legislate in all matters not expressly reserved to the French State. However, the division of competences relating to deep-sea mining is unclear. In fact, article 47 of the Organic Law grants French Polynesia authority over the exploration and exploitation of seabed and EEZ natural resources.[70] But article 14 of the Organic Law reserves to the French state the competence when it comes to strategic raw materials.[71] An official list of these strategic resources does not exist, meaning that all seabed resources could potentially be classified as strategic. This uncertainty creates tensions regarding the division of competences

[66] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 192.
[67] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 194.
[68] The Ocean Foundation and Bobbi-Jo Dobush, rep., *Deep Seabed Mining (DSM) Risk and Liability Considerations*, 2023, 8-9.
[69] "Loi Organique N° 2004-192 DU 27 Février 2004 Portant Statut d'autonomie de La Polynésie Française (1).," Loi organique n° 2004-192 du 27 février 2004 portant statut d'autonomie de la Polynésie française (1). - Légifrance, accessed April 22, 2025, https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000435515.
[70] "Loi Organique N° 2004-192 Du 27 Février 2004 Portant Statut d'autonomie de La Polynésie Française (1)." Article 47 - Loi organique n° 2004-192 du 27 février 2004 portant statut d'autonomie de la Polynésie française (1). - Légifrance. Accessed April 22, 2025. https://www.legifrance.gouv.fr/loda/article_lc/LEGIARTI000038741734.
[71] "Loi Organique N° 2004-192 Du 27 Février 2004 Portant Statut d'autonomie de La Polynésie Française (1)." Article 14 - Loi organique n° 2004-192 du 27 février 2004 portant statut d'autonomie de la Polynésie française (1). - Légifrance. Accessed April 22, 2025. https://www.legifrance.gouv.fr/loda/article_lc/LEGIARTI000038741667.

over seabed resources. Given potentially overlapping jurisdictions, this section examines the existing liability regimes of both French Polynesia and France, concluding that neither adequately addresses the unique risks posed by deep-sea mining.

France's Liability Regime

French Law does not currently impose full responsibility on companies for the environmental consequences of their actions because of economic, political and legal obstacles linked to a company's legal personality. Nevertheless, France was one of the first countries to create a "duty of vigilance," imposing an obligation on companies to take into consideration various risks related to human rights violations and environmental damage as part of their operations, both in France and internationally.

In the wake of the Rana Plaza's collapse, France enacted the Law of March 27, 2017, introducing a duty of vigilance for large companies.[72] The law's objective was to impose obligations on companies to prevent further human rights violations and environmental damage as well as to facilitate victim compensation. This section will first analyze what this duty entails, before looking at its shortcomings in the context of deep-sea mining.

Scope of the French Duty of Vigilance:

The duty of vigilance set out in article L.255-102-1 of the French Code of Commerce is restricted to companies with at least **five thousand employees** "within the company and its direct or indirect subsidiaries whose registered office is in France, or at least ten thousand employees within the company and its direct or indirect subsidiaries whose registered office is in France or abroad." Its scope of application is also limited to "**serious violations of human rights and fundamental liberties, human health and safety, and the environment**." Therefore, the duty does not cover a variety of other risks, such as those linked to corruption.

The duty of vigilance requires covered companies to monitor the activities of their economic partners, particularly those within their chain of operations, including subsidiaries, subcontractors, and suppliers. Under the French Commercial Code, the parent company must exercise vigilance over all activities carried out by "the company and those of the companies it controls within the meaning of Article L. 233-16 II, directly or indirectly, as well as the activities of subcontractors or suppliers with whom it has an established business relationship, when these activities are linked to this relationship."[73]

In addition to this general duty of vigilance, company management is now required to consider the social and environmental impacts of the company's activities when defining and pursuing its corporate interest.[74] For certain companies, there is even the additional obligation of creating and implementing a compliance plan (called a "*plan de vigilance*"). As mentioned above, the law

[72] "Loi N° 2017-399 Du 27 Mars 2017 Relative Au Devoir de Vigilance Des Sociétés Mères et Des Entreprises Donneuses d'ordre (1)," LOI n° 2017-399 du 27 mars 2017 relative au devoir de vigilance des sociétés mères et des entreprises donneuses d'ordre (1) - Légifrance, accessed April 22, 2025, https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000034290626/.
[73] Article L225-102-1 - Code de commerce - Légifrance, accessed April 23, 2025, https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000047926145.
[74] Article 1833 - Code civil - Légifrance, accessed April 23, 2025, https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000038589931.

aims to prevent damage from occurring and, if any damage does occur, to facilitate victim compensation. In practice, this mean that:

- A company is required to make its best efforts to identify and prevent the occurence of a social or environmental risk. The Code of Commerce provides that the company may be given formal notice to comply with these obligations and, if it fails to do so within three months of receiving formal notice, a court may order compliance and impose a fine where necessary.[75]

- The company may then be held liable for social or environmental damage. Article L. 225-102-2 of the Code of commerce refers to the general civil liability regime. This means that the company may be held liable both for damage caused by its own activity and for damage resulting from its subsidiaries' or subcontractors' activities, which it had an obligation to monitor.

While the 2017 duty of vigilance may seem innovative and particularly useful in the case of deep-sea mining, it is not without shortcomings. To begin with, the aim of the law that created the duty was to *prevent* damage from happening. However, under the French general civil liability regime, liability is only established if there is proof of actual damage. Thus, a company's *ex ante* liability is not truly feasible. One would have to wait for the seabed to be damaged before actually being able to bring a claim.

In addition, the scope of the duty of vigilance is restricted. The regime will only apply to companies of a substantial size. While large companies will probably dominate the deep-sea mining industry given the significant costs involved, smaller companies that may participate in such operations would not be subject to the duty of vigilance and its liability regime. Further, only substantial violations of human rights and fundamental liberties, human health and safety, and the environment, are covered by the regime. It is unclear what a "substantial" violation might be, but it certainly means that not *all* violations of human rights and *all* environmental damage will be covered.

But, what about these *other* violations? Would they also be subject to the French general civil liability regime? This question is particularly important since the general civil liability regime provides specific reparation for environmental damage,[76] but courts have yet to clarify how these regimes will interact (i.e., whether they could both apply or will be mutually exclusive). Furthermore, assuming that a claim could be made, the victim seeking compensation would encounter many evidentiary issues. They would bear the burden of proving their claim, including: the parent company's fault; the subsidiary's or subcontractor's fault; the damage; and causation between fault and damages.

[75] Article L225-102-1 - Code de commerce - Légifrance, accessed April 23, 2025, https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000047926145.
[76] Chapitre III : La réparation du préjudice écologique (Articles 1246 à 1252) - Légifrance, accessed April 23, 2025, https://www.legifrance.gouv.fr/codes/section_lc/LEGITEXT000006070721/LEGISCTA000033019029/.

It would also be difficult to hold a company's shareholders, directors or ultimate beneficial owners liable. Shareholders are immune from liability under French law for the decisions made by a company's management. Directors could only be held liable if French courts found that ignoring these human and environmental risks constituted mismanagement. Finally, perhaps most importantly, French Law only applies to French parent companies. Depending on the circumstances, that means non-French companies generating damages with consequences in French Polynesia will not be subject to French Law, rendering the duty of vigilance useless in bringing claims against them.

For these reasons, the French liability regime based on the duty of vigilance is insufficient by itself to make deep-sea mining companies fully liable in the event of damages, and to prevent and repair any damage caused by commercial exploitation. A broader mechanism, ideally a global mechanism, would address some of the difficulties discussed above. In this regard, it is important to note that the European Union (EU) is currently working on a European directive that may replace the national duties of vigilance in the EU and impose a common standard, which could pave the way for a global mechanism by serving as an example. The EU Directive, which is suspended for the time being, aims to regulate in a single text all aspects of sustainability, including provisions on information and behavior.

The proposed European Directive on the Duty of Vigilance:

After a lengthy negotiation process, the European authorities adopted the Duty of Vigilance Directive in June 2024. Over the course of several years, three texts were renegotiated: the Due Diligence Directive, the Sustainability Reporting Directive,[77] and the Taxonomy Regulation.[78] All three texts will be merged into a single, simplified directive: the Omnibus Directive. It has been under discussion since February 26, 2025. Discussions are ongoing and there is still uncertainty regarding which provisions will be maintained. Transposition of the Duty of Vigilance Directive has been suspended for the time being, pending adoption of the Omnibus Directive.[79]

Following in the Duty of Vigilance Directive's footsteps, the proposed Omnibus Directive proposes the creation of an administrative supervisory authority to monitor *ex ante* compliance with the companies' duty of vigilance. This authority could have considerable enforcement powers to ensure the effective prevention of social and environmental damage.[80] Companies could thus be subject to administrative sanctions in the event of a breach of their duty of vigilance, regardless of whether any actual damage occurred, given the duty of vigilance's

[77] "Directive - 2022/2464 - EN - CSRD Directive - EUR-Lex," EUR, accessed April 23, 2025, https://eur-lex.europa.eu/eli/dir/2022/2464/oj/eng.
[78] "Regulation - 2020/852 - EN - Taxonomy Regulation - EUR-Lex," EUR, accessed April 23, 2025, https://eur-lex.europa.eu/eli/reg/2020/852/oj/eng.
[79] "Lex - 2025_44 - EN - EUR-Lex," EUR, accessed April 23, 2025, https://eur-lex.europa.eu/procedure/EN/2025_44.
[80] "Amending Directives (EU) 2022/2464 and (EU) 2024/1760 as Regards the Dates from Which Member States Are to Apply Certain Corporate Sustainability Reporting and Due Diligence Requirements - Thursday, 3 April 2025," europarl.europa.eu, accessed April 23, 2025, https://www.europarl.europa.eu/doceo/document/TA-10-2025-0064_EN.html.

preventive goals. Such a united and preventive European approach could be particularly effective in the context of deep-sea mining.

French Polynesia's Liability Regime

While several voices, including President Moetai Brotherson,[81] have opposed deep-sea mining, that opposition is not clearly reflected in French Polynesia's laws. Exploitation of the deep seabed's resources may fall under French Polynesian competence, prompting an examination of its specific liability regime. Several issues arise.

First, the French Polynesian Mining Code[82] establishes a complete regime regarding land-based mining activities. It does not, however, mention deep-sea mining activities or the seabed's specific resources. In addition, this liability regime is not adapted to the unique challenges posed by the industry, as further detailed below.

The French Polynesian Environmental Code sets the management and protection of natural resources, including maritime resources, as one of French Polynesia's priorities.[83] It also imposes a duty on each citizen to safeguard French Polynesia's environment as well as to repair any damage they may cause.[84] It even puts in place various reparation measures that should be taken by an entity harming the environment, the priority being to restore the environment to its original state and prevent any harm to human health.[85] The ground and water supplies are expressly mentioned as specific areas to be repaired.[86] However, the relevant section does not specifically mention the seabed as an environment to be repaired.

Liability for corporate actors involved in deep-sea mining activities is also not clearly established by either the Mining Code or the Environmental Code. In fact, no mention is made of piercing the corporate veil to hold relevant parties, such as corporate directors and shareholders, liable. These legislation also do not specify who bears the burden of proof for environmental and other damages from deeps-sea mining, or the relevant jurisdiction to bring suit. These unanswered questions mean that the current existing liability regime may shield ultimate owners for damages

[81] "'Playing Gods with the Cradle of Life': French Polynesia's President Issues Warning over Deep-Sea Mining," The Guardian, March 31, 2025, https://www.theguardian.com/world/2025/apr/01/french-polynesia-deep-sea-mining-pacific-warning-president-moetai-brotherson.
[82] "Code Des Mines et Des Activités Extractives de La Polynésie française", Lexpol, accessed May 1, 2025, https://lexpol.cloud.pf/LexpolAfficheTexte.php?texte=581578.
[83] "Code de l'environnement," DIREN, art. LP. 1100-1, Accessed May 15, 2025, https://www.service-public.pf/diren/partager/code/.
[84] "Code de l'environnement," DIREN, art. LP. 1510-1, Accessed May 15, 2025, https://www.service-public.pf/diren/partager/code/.
[85] "Code de l'environnement," DIREN, art. LP. 1522-3 , Accessed May 15, 2025, https://www.service-public.pf/diren/partager/code/.
[86] "Code de l'environnement," DIREN, art. LP. 1530-2, Accessed May 15, 2025, https://www.service-public.pf/diren/partager/code/.

from commercial exploitation, and make it more difficult for affected individuals or communities to seek redress.

Second, in the absence of a specific liability regime, the law reverts to the common extra-contractual civil liability regime. A first difficulty arises as it is unclear which parts of French Civil Law apply to French Polynesia. It seems that, for each French Civil Code article, one must distinguish whether they were enacted before or after the 2004 Organic Law, and whether they fall under French competence or French Polynesian competence.[87] This poses significant legal clarity and accessibility issues. Moreover, the French regime which served as the basis for the French Polynesian one was amended by a significant Civil law reform in 2016.[88] This reform incorporated specific provisions relating to environmental damage and reparation. However, this reform was not enacted in French Polynesia, and these provisions are not included in French Polynesian Civil Law.[89]

The French Polynesian regime thus lacks specific liability provisions regarding environmental damage. The provisions currently in place also raise several issues, similar to the ones mentioned in this section's discussion of the French regime. It is unclear whether these provisions would apply to entities that are not French Polynesian; depending on the circumstances, these entities may not be subject to French Polynesian Law, rendering these provisions useless to bring claims against such entities for damages from deep-sea mining taking place in French Polynesia.

In sum, French Polynesian law does not seem to enable piercing the corporate veil to hold all actors, including the ultimate beneficial owners of a corporation, liable for damage from deep-sea mining activities. It is also unclear which jurisdiction would be competent to hear specific claims related to such damage. In addition, the plaintiff would bear the burden of proving all elements of their liability claim,[90] not the mining entities who will potentially have much more information on the extent of the damage. Finally, applicable legislative provisions only enable reparation once the damage has already occured.

For these reasons, the French Polynesian liability regime lacks the specificity required to address the unique liability risks posed by deep-sea mining.

The Need for Air-Tight Liability in Guarding Against a "Race to the Bottom"

Deficiencies in current liability regimes, whether at the international or domestic level, highlight the need for significant reform to prevent a "race to the bottom". In fact, without a specific and far-reaching liability framework, countries are incentivized to issue permits for deeps-sea mining

[87] Pascal Gourdon, *CODE CIVIL APPLICABLE EN POLYNÉSIE FRANÇAISE Comprenant La Traduction En Langue Tahitienne d'une Centaine d'articles* (Polydroit, 2023), X-X
[88] "Ordonnance N° 2016-131 DU 10 Février 2016 Portant Réforme Du Droit Des Contrats, Du Régime Général et de La Preuve Des Obligations," Ordonnance n° 2016-131 du 10 février 2016 portant réforme du droit des contrats, du régime général et de la preuve des obligations - Légifrance, accessed April 23, 2025, https://www.legifrance.gouv.fr/loda/id/JORFTEXT000032004939
[89] Pascal Gourdon, *CODE CIVIL APPLICABLE EN POLYNÉSIE FRANÇAISE Comprenant La Traduction En Langue Tahitienne d'une Centaine d'articles* (Polydroit, 2023), 584-584
[90] Pascal Gourdon, *CODE CIVIL APPLICABLE EN POLYNÉSIE FRANÇAISE Comprenant La Traduction En Langue Tahitienne d'une Centaine d'articles* (Polydroit, 2023), 596-596

with minimal requirements to attract commercial activity, without regard for potentially devastating damages with transboundary implications.

In this context, the ISA's role is essential. But domestic legislation is also key to closing any liability gaps. Air-tight liability frameworks are required at both levels. Such frameworks must be sufficiently clear and specific to hold any and all deep-sea mining actors liable for any and all damage that could occur.

This chapter now turns to other key legal issues, starting with concerns around integrity and transparency within the ISA. These issues are closely tied to the liability challenges discussed above, as inadequate disclosures and restricted access to information undermine accountability. Transparent access to data, such as the beneficial ownership of contractors and environmental information about proposed mining zones, is crucial for seeking redress and enforcing safeguards. Integrity concerns also raise questions about whether the ISA is positioned to adopt the necessary regulatory actions to prevent harm. Without appropriate institutional processes, the adoption and enforcement of essential protective measures may be compromised. The chapter will then turn to other important legal issues, namely: risks and uncertainties regarding labor regulations, and potential financial liability arising from investor-state disputes.

Transparency and Conflicts of Interest Issues at the ISA

This section examines integrity concerns within the ISA and the adequacy of its corporate disclosure requirements for contractors. It concludes that significant issues exist in this regard, including inadequate transparency of environmental data, internal conflicts of interest, and persistent shortcomings in corporate transparency, such as limited disclosure of beneficial ownership. As mentioned above, these deficiencies weaken the ISA's capacity to effectively regulate deep-sea mining operations and may obstruct affected parties from seeking redress for harm. They also reduce the likelihood that environmental damage can be prevented in the first place

Transparency Deficiencies

Lack of Public Access to Environmental and Financial Data

Transparency is widely recognized as a necessary component of good governance, both within state governments as well as international institutions.[91] However, the ISA has consistently failed to disclose environmental data and contractor reports, violating UNCLOS Annex III, Article 14, which mandates non-confidential environmental safety data be made public.[92] Based on a transparency assessment compared with the high seas fisheries sector also operating in areas beyond national jurisdictions, the ISA scores 44% on transparency metrics in overall, which is

[91] James R. Hollyer, B. Peter Rosendorff, and James Raymond Vreeland, "Democracy and Transparency", *The Journal of Politics* 73, no. 4 (2011): 1191–1205, https://doi.org/10.1017/s0022381611000880.
[92] "UNCLOS and Agreement on Annex III, Article 14", accessed 15 April 2025, https://www.un.org/depts/los/convention_agreements/texts/unclos/closindx.htm.

significantly below regional fisheries organizations (77%), reflecting systemic institutional failures.[93]

In 2019, the ISA launched the public database DeepData as a repository of deep-seabed-related data collected by contractors and other parties. The database holds both geological data, categorized as confidential, and publicly available environmental data. However, the DeepData database, intended to make environmental data accessible, appears not to be regularly populated with new data and is difficult to use.[94] It includes many duplicate and misnamed species records, and has limited accessibility (data are classified into "confidential" and "public" at the discretion of the contractor). The database also lacks supporting metadata explaining how the data were collected, among other technical considerations essential for proper scientific interpretation and analysis.[95] Scholars therefore lack an important resource to conduct research and analyze the environmental baseline information collected to date as well as the potential environmental effects of exploitation.

In addition, the ISA refuses to publish full mining contracts or even summary forms, keeping financial obligations and operational terms confidential. Annual reports by contractors, which are required for compliance, also remain secret, and the ISA has not reported whether contractors have been in compliance with their contractual obligations.[96] This lack of transparency is compounded by the fact that the ISA Council, the executive organ that oversees the implementation of deep-sea mining regulations, has never terminated a contractor for non-compliance.[97] This record underlines the difficulty in ensuring that contractors meet their disclosure obligations.

While public information is lacking, The Metals Company (TMC), a key industry player, was found to have received priority access to environmental data before developing sponsors, violating ISA's mandate to ensure fair resource distribution. Interviews and hundreds of pages of emails, letters and other internal documents show that the firm's executives received key information from the ISA beginning in 2007, giving a major edge to their mining ambitions. The ISA shared data identifying some of the most valuable seabed tracts, and then set aside the prized sites for the company's future use, according to the materials.[98]

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[93] Jeff A. Ardron, "Transparency in the Operations of the International Seabed Authority: An Initial Assessment", *Marine Policy* 95 (1 September 2018): 324–31, https://doi.org/10.1016/j.marpol.2016.06.027.

[94] M Rabone et al., "A Review of the International Seabed Authority Database DeepData from a Biological Perspective: Challenges and Opportunities in the UN Ocean Decade", *Database* 2023 (1 January 2023): baad013, https://doi.org/10.1093/database/baad013.

[95] Kanae Komaki and David Fluharty, "Options to Improve Transparency of Environmental Monitoring Governance for Polymetallic Nodule Mining in the Area", *Frontiers in Marine Science* 7 (30 April 2020): 247, https://doi.org/10.3389/fmars.2020.00247.

[96] Jeffrey Allan Ardron, "Good Governance of Deep-Seabed Mining:Transparency and the Monitoring of Environmental Harm" (phd, University of Southampton, 2020), https://eprints.soton.ac.uk/444729/.

[97] "Push to Mine Ocean Floor Raises Concerns over International Seabed Authority - Los Angeles Times", accessed 16 April 2025, https://www.latimes.com/politics/story/2022-04-19/gold-rush-in-the-deep-sea-raises-questions-about-international-seabed-authority.

[98] "Secret Data, Tiny Islands and a Quest for Treasure on the Ocean Floor - The New York Times", accessed 15 April 2025, https://www.nytimes.com/2022/08/29/world/deep-sea-mining.html.

Closed-Door Legal and Technical Commission (LTC) and Finance Committee Meetings

The ISA's technical and scientific advisory body, the LTC, is responsible for drafting mining regulation and is in charge of compliance oversight. Unlike the ISA Assembly and Council, which allow observer access, the LTC[99] and Finance Committee[100] meetings are held in private. Only those states with a national serving on the LTC have a direct view into the body's discussions. Members have reportedly nominated non-experts just to know what is happening within the organ. The closed-door nature of LTC sessions raises serious transparency concerns regarding the drafting of regulations, review of applications and environmental impact assessments (EIAs), and compliance monitoring.

Official LTC documents marked with an "L." (limited) or an "R." (restricted) designations are confidential. Other official LTC documents are publicly accessible online. However, all contractor annual reports and contract applications submitted to the LTC are treated as confidential (i.e., marked with R. or L. designations).[101] The LTC summary reports to the Council, which are meant to support their recommendations (e.g., to approve an application from a State/contractor), do not detail the rationale behind their recommendations.[102] This lack of transparency hinders oversight of the decision-making process and may obscure undisclosed interactions between the LTC and contractors.

Resistance to Transparency Reforms

Despite multiple requests from the ISA Council and Assembly for increased transparency, no substantive reforms have been implemented. UNCLOS article 154 requires the ISA to undergo an internal review every five years.[103] An independent consultancy released its interim report in 2016.[104] This report detailed transparency issues and made four (out of 34) recommendations focusing on the need for greater transparency. The consultants explain, for example, that the ISA should develop a policy on transparency and conflicts of interest, and revise its regulations to set confidentiality standards. However, no such recommendation made its way to the ISA's review committee report.[105]

[99] "Decision of the Council of The Authority Concerning the Rules of Procedure of the Legal and Technical Commission", accessed 16 April 2025, https://www.isa.org.jm/wp-content/uploads/2023/05/isba_6_c_9_rop_of_ltc.pdf.
[100] "ISBA/5/FC/1 - International Seabed Authority", 18 July 2022, https://www.isa.org.jm/mining_code/isba-5-fc-1/.
[101] "Decision of the Council of The Authority Concerning the Rules of Procedure of the Legal and Technical Commission", accessed 16 April 2025, https://www.isa.org.jm/wp-content/uploads/2023/05/isba_6_c_9_rop_of_ltc.pdf.
[102] Jeff A. Ardron, "Transparency in the Operations of the International Seabed Authority: An Initial Assessment", *Marine Policy* 95 (1 September 2018): 324–31, https://doi.org/10.1016/j.marpol.2016.06.027.
[103] "UNCLOS and Agreement on Annex III, Article 154", accessed 20 May 2025, https://www.un.org/depts/los/convention_agreements/texts/unclos/closindx.htm.
[104] Prof. David Johnson, Prof. Philip Weaver, Dr Vikki Gunn, et al., "Periodic Review of the International Seabed Authority pursuant to UNCLOS Article 154", accessed 16 April 2025, https://www.isa.org.jm/wp-content/uploads/2022/06/isba-22a-crp.3-1.pdf.
[105] "Decision of the Assembly of the International Seabed Authority relating to the final report on the first periodic review of the international regime of the Area pursuant to article 154 of the United Nations Convention on the Law of the Sea", 4 April 2023, https://www.isa.org.jm/documents/isba-23-a-13/.

Conflicts of Interest within the LTC

Individuals who provide advice to the ISA are required to have no financial interest in activities related to deep-sea exploration or mining beyond national jurisdiction. This requirement is enshrined in UNCLOS.[106] However, some LTC members appear to be directly employed by ISA contractors or by governments with national policies aimed at securing financial benefits from deep-sea mining in the Area. No information appears to be provided to the Council or the public regarding LTC members' conflict-of-interest declarations or how potential conflicts are managed.

An example of conflicts of interest at the ISA involves Kiribati's ambassador allegedly offering Leticia Reis de Carvalho, the current ISA Secretary-General, a high-level job at the ISA in exchange for her withdrawal from the Secretary-General race. According to The New York Times, Ambassador Teburoro Tito confirmed that the deal was intended to help secure a third term for Mr. Lodge, the incumbent Secretary-General, and that Mr. Lodge had approved the plan as part of his re-election strategy.[107] Notably, Kiribati is one of three small Pacific nations, alongside Nauru and Tonga, that have sponsored TMC's applications for mining access. Thus, Kiribati's efforts to keep Mr. Lodge in power indirectly serve TMC's interests, illustrating how industry actors can exert influence over ISA leadership through state sponsors.

[106] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), art. 163(8), 168(2).
[107] Eric Lipton, "Fight Over Seabed Agency Leadership Turns Nasty", New York Time, 4 July 2024, https://www.nytimes.com/2024/07/04/us/politics/seabed-agency-mining.html.

Another example of conflicts of interest and the "revolving door" phenomenon at the ISA is the agency's employment of consultants and staff lawyers who have previously worked for mining companies with matters pending before the ISA. Internal documents and employee complaints have raised alarms about this practice.[108]

In addition to problematic industry ties and political influence within the LTC, some have raised concerns about the LTC's credibility. The LTC faces an overwhelming workload and lacks adequate environmental expertise among its members to effectively fulfill its broad responsibilities.[109] These issues are exacerbated by structural shortcomings in transparency and accountability. As a result, the legitimacy of ISA decisions based on LTC recommendations is increasingly called into question.[110]

Weak Corporate Transparency

While concerns over the competence, impartiality, and opacity of ISA's internal organs like the LTC highlight institutional transparency challenges, an equally critical dimension involves how information, particularly environmental and resource-related data, is collected, classified, and disclosed. The current regulatory framework has been criticized for granting contractors excessive discretion to determine their own data reporting requirements, including what data is deemed confidential.[111]

This section discusses the challenges surrounding corporate transparency within the ISA, focusing on three issues: (1) contractors' excessive discretion on what data is deemed confidential; (2) gap in beneficial ownership structures disclosure; and (3) weak disclosure requirements compared to national and international standards. Despite increasing regulatory pressure, the ISA has failed to enforce standardized disclosure practices, allowing contractors to disproportionately influence what environmental data is shared publicly and what is withheld.

Excessive Discretion on What Data is Deemed Confidential

UNCLOS fails to define criteria for classifying confidential information or establish a transparent process for determining exceptions. The ISA gives excessive discretion to contractors in determining what data is considered confidential.

Under the ISA's Mining Code, contractors retain disproportionate power to identify information as confidential through consultations with the Secretariat. The Secretary-General's Information

[108] Eric Lipton, "Secret Data, Tiny Islands and a Quest for Treasure on the Ocean Floor," New York Times, August 29, 2022, https://www.nytimes.com/2022/08/29/world/deep-sea-mining.html.
[109] "3rd Part of the 28th Annual Session of the International Seabed Authority", IISD Earth Negotiations Bulletin, 8 August 2017, https://enb.iisd.org/international-seabed-authority-isa-council-28-3.
[110] "Ready to Regulate? The International Seabed Authority on the Brink of Commercial Mining", accessed 15 April 2025, https://dlc.dlib.indiana.edu/dlc/items/b05c8212-2012-4de9-b9d4-bdf3bfdcd5a6.
[111] Jeff Ardron, Hannah Lily, and Aline Jaeckel, "Public Participation in the Governance of Deep-Seabed Mining in the Area", in *Research Handbook on International Marine Environmental Law*, ed. Rosemary Rayfuse, Aline Jaeckel, and Natalie Klein (Edward Elgar Publishing, 2023), 361–84, https://doi.org/10.4337/9781789909081.00026.

Sensitivity, Classification, and Handling Bulletin[112] further entrenches this ambiguity by vaguely categorizing "proprietary or commercially sensitive information" without operational definitions. As a result, ISA's default practice presumes that all contractor-submitted data is confidential unless it falls under narrow exceptions (e.g., pre-existing public availability). This creates a regime where secrecy is the norm.

The absence of binding criteria enables contractors to exploit confidentiality claims to withhold critical data, particularly geological and operational information. For instance, geological surveys (e.g., polymetallic nodule density maps) are routinely labeled as "commercially sensitive" without evidence that disclosure would harm legitimate business interests. Contractors argue that competitors could replicate mining strategies using such data, yet the ISA does not require such proof.[113] A contractor should be required to demonstrate how its exclusive commercial access to minerals in its mining areas would be impacted if others also had access to geological information. Simply labeling information as "confidential" and then treating it as such, as is current ISA practice, is not sufficient justification.

While the Draft Regulations on Exploitation of Mineral Resources in the Area (Draft Exploitation Regulations)[114] require States, the ISA, and contractors to cooperate with a view to "sharing, exchanging and assessing environmental data and information for the Area" and to "promote accountability and transparency […] including through the timely release of and access to relevant environmental data and information and opportunities for stakeholder participation", critical gaps persist. The Regulations do not distinguish between "raw environmental data" (e.g., baseline biodiversity metrics) and "processed analyses" (e.g., proprietary risk models), allowing contractors to redact the latter under confidentiality claims. The Secretary-General may permit temporary nondisclosure for "bona fide academic reasons," but this exemption lacks clear boundaries. For instance, could a contractor indefinitely delay publication by claiming ongoing research?

The lack of transparency around environmental and other data, when not supported by legitimate justification, is concerning, as it prevents public scrutiny and limits the ability of affected parties to assess potential risks or seek redress for harm. For example, it can make it more difficult to link specific environmental impacts directly to deep-sea mining activities.

Gap in Beneficial Ownership Structures Disclosure

Moreover, the incentives of some member states to hold contractors to account are mixed, given that sponsoring states with small economies could stand to gain revenues from both taxes and ISA benefit-sharing. Contractors may take advantage of the ISA regime regarding state

[112] "Information Sensitivity, Classification and Handling | HR Portal", accessed 16 April 2025, https://hr.un.org/content/information-sensitivity-classification-and-handling.
[113] David Bosco, Aline Jaeckel, and Pradeep Singh, *Ready to Regulate? The International Seabed Authority on the Brink of Commercial Mining* (Bloomington, IN: Ostrom Workshop, 2023), https://ostromworkshop.indiana.edu.
[114] "Draft Regulations on Exploitation of Mineral Resources in the Area," ISBA/29/C/CRP.1, February 16, 2024, accessed April 15, 2025, https://www.isa.org.jm/wp-content/uploads/2024/02/Consolidated_text.pdf.

sponsorship by seeking "sponsors of convenience," that is, sponsoring states who tacitly agree to regulate mining firms lightly in exchange for direct financial gains. Because contractors are not required to disclose their beneficial ownership structures, the public and other member states have little visibility into such arrangements.

The opacity of beneficial ownership structures among deep-sea mining contractors creates systemic risks, including environmental accountability gaps and regulatory arbitrage. At the heart of this issue lies the deliberate opacity of corporate control chains, where contractors exploit legal loopholes and weak governance in small sponsoring states to obscure their true beneficiaries.

For instance, TMC secured three exploration contracts in the Clarion-Clipperton Zone (CCZ) through subsidiaries registered in Nauru (NORI),[115] Tonga (TOML),[116] and Kiribati (Marawa)[117] without even a mention of its name in any one of the applications that were submitted to and approved by the ISA.

This intentional fragmentation of corporate identity allows companies to evade scrutiny while operating under the jurisdiction of sponsoring states that lack the capacity or political will to enforce robust environmental or social safeguards.

Another case involving Jamaica's stance on liability for deep-sea mining activities, illustrates the dangers of opaque beneficial ownership structures and outdated disclosure practices. Jamaica's government denies liability for exploration activities conducted by Blue Minerals Jamaica Ltd, a contractor sponsored by the state but ultimately controlled by the UK-listed Anglo American plc (LSE: AAL). Blue Minerals Jamaica Ltd is nominally a Jamaican entity, but its beneficial owner, Anglo American, operates through layers of subsidiaries and offshore entities. This structure allows Anglo American to legally distance itself from environmental or financial risks, while Jamaica bears reputational and regulatory burdens as the sponsor state.

The Jamaican Senator questioned why ownership transfer had not been reflected in the records of the Companies Office of Jamaica, adding that the company was set up in 2018 in what appears to be "a shell to protect the identity of the ultimate owners, and six years later, no adjustment has been made to the record".[118] While Jamaica claims it merely acts as a "sponsor" under the ISA rules, the lack of clarity around Anglo American's operational control and financial obligations exposes a critical flaw: without real-time, accurate ownership data, accountability becomes a jurisdictional shell game.

[115] Nauru Ocean Resources, "Application for Approval of a Plan of Work for Exploration for Polymetallic Nodules in the Area by Nauru Ocean Resources Incorporated", 21 June 2011, https://digitallibrary.un.org/record/818492.
[116] "Tonga Offshore Mining Ltd.: Application for Approval of a Plan of Work for Exploration", 14 June 2011, https://digitallibrary.un.org/record/705252.
[117] Exploration (Kiribati) Marawa Research, "Application for approval of a plan of work for exploration for polymetallic nodules in the Area by Marawa Research and Exploration Ltd. : executive summary", 11 June 2012, https://digitallibrary.un.org/record/729862.
[118] Edmond Campbell, "Jamaica Not Liable for Deep-Sea Mining Company's Exploration, Says Johnson Smith", accessed 15 April 2025, https://jamaica-gleaner.com/article/lead-stories/20241111/jamaica-not-liable-deep-sea-mining-companys-exploration-says-johnson.

Inconsistency with National and International Disclosure Standards

Weak disclosure requirements are also a persistent issue within the ISA, particularly regarding environmental, social, and governance (ESG) reporting. This section explores the global shift toward stronger ESG disclosure requirements at both national and international levels. It then compares these emerging standards with the ISA's current approach to contractor disclosure, highlighting key inconsistencies between broader regulatory trends and the ISA's limited requirements.

This section explores the global shift toward mandatory ESG reporting, highlighting key developments across jurisdictions and the growing influence of international standards. In fact, the global corporate disclosure landscape has significantly evolved over the last decades, particularly with regard to ESG issues. Driven by growing investor demand, regulatory pressures, and shifting societal expectations, companies are increasingly expected to disclose more about their ESG practices. The notable shift in this area is the transition from voluntary to mandatory reporting, reflecting a regulatory push to standardize and enforce ESG disclosures across different jurisdictions.

The formation of the International Sustainability Standards Board (ISSB) by the International Financial Reporting Standards (IFRS) Foundation in 2021 is a major development.[119] The ISSB aims to establish global standards for sustainability disclosures, thereby improving consistency and transparency in ESG reporting. This move underscores the shift towards global alignment and mandatory ESG disclosure requirements, ensuring that companies provide comprehensive and comparable information to stakeholders worldwide.

Global stock exchanges and securities administrations have also played a significant role in promoting ESG transparency. They have increasingly introduced sustainability indices and ESG-related corporate governance rules.

- In 2024, the **U.S. Securities and Exchange Commission** adopted amendments to its rules under the Securities Act of 1933 and Securities Exchange Act of 1934, which will require registrants to provide certain climate-related information in their registration statements and annual reports.[120]

- In the same year, the **Canadian Sustainability Standards Board** (CSSB) released its sustainability standards for disclosure of sustainability-related financial information and climate-related disclosures.[121] Following the release of the CSSB Standards, the

[119] "IFRS - International Sustainability Standards Board", accessed 16 April 2025, https://www.ifrs.org/groups/international-sustainability-standards-board/#resources.
[120] "SEC.Gov | The Enhancement and Standardization of Climate-Related Disclosures for Investors", accessed 16 April 2025, https://www.sec.gov/rules-regulations/2024/03/s7-10-22.
[121] "Media Release – Canadian Sustainability Standards Board Announces First Canadian Sustainability Disclosure Standards for Public Consultation", accessed 16 April 2025, https://www.frascanada.ca/en/sustainability/projects/adoption-csds1-csds2/media-release-cssb-public-consultation.

Canadian Securities Administrators announced to work towards a revised climate-related disclosure rule that will consider the CSSB Standards and include modifications considered appropriate for the Canadian capital markets.

- Similarly, the **Hong Kong Stock Exchange** first introduced its ESG Reporting Guide in 2013 and updated continuously.[122] The latest guideline requires listed companies to disclose specific environmental indicators, including greenhouse gas emissions, energy consumption, and water usage, in order to enhance transparency and comparability.

Furthermore, exchanges are using incentive-based systems to encourage higher ESG performance. The Corporate Sustainability Index in Brazil[123] and the Jantzi Social Index in Canada[124] categorize companies based on their ESG performance, rewarding high-compliance firms with reputational benefits and attracting long-term investors. These incentives push companies to not just meet regulatory requirements but go beyond them, fostering a more sustainable business environment.

Across the world, national regulations have also evolved to ensure that companies disclose important environmental information. These regulations vary by country but are increasingly aligning with global expectations to improve transparency and accountability in business operations.

- In **Australia**, the Environmental Protection and Biodiversity Conservation Act (EPBC Act)[125] continues to require companies to report specific pollutant emissions through the National Pollutant Inventory and aims at streamlining the assessment process for certain projects, reducing delays in development approvals, and enhancing transparency. In the United States, the Dodd-Frank Act (2010)[126] remains a key regulation that mandates project-level payment disclosures, indirectly pressuring companies to address environmental risks.

- In the **European Union**, the Transparency Directive (2013) continues to require extractive companies to disclose environmental risks and payments linked to projects, ensuring accountability for environmental impacts, including climate change. This regulation has been supplemented by the Corporate Sustainability Reporting Directive (CSRD) introduced in 2021,[127] which extends mandatory ESG reporting to all large

[122] "Rules and Regulations", accessed 16 April 2025, https://www.hkex.com.hk/Listing/Sustainability/ESG-Academy/Rules-and-Regulations?sc_lang=en.
[123] "Corporate Sustainability Index (ISE B3) | B3", accessed 16 April 2025, https://www.b3.com.br/en_us/market-data-and-indices/indices/sustainability-indices/corporate-sustainability-index-ise-b3.htm.
[124] "Jantzi Social | Morningstar Indexes", accessed 16 April 2025, https://indexes.morningstar.com/indexes/details/jantzi-social-FS0000ILMP?currency=USD&variant=TR&tab=overview.
[125] *Environment Protection and Biodiversity Conservation Act 1999* (Cth), Compilation No. 64, registered April 11, 2025.
[126] *Dodd-Frank Wall Street Reform and Consumer Protection Act*, Pub. L. No. 111-203, 124 Stat. 1376 (2010).
[127] "Sustainable Finance Package - European Commission", accessed 16 April 2025, https://finance.ec.europa.eu/publications/sustainable-finance-package_en.

companies and those listed on EU stock exchanges. This regulation requires more than 50,000 companies[128] to disclose detailed sustainability information, including environmental impacts, social responsibility, and governance structures, aiming to improve the quality and consistency of ESG disclosures. The CSRD is a significant step toward harmonizing reporting requirements across the EU, ensuring that companies are held accountable for their environmental and social impacts.

- International frameworks like the **Global Reporting Initiative** (GRI)[129] are pivotal in creating globally recognized standards for ESG reporting. Over 10,000 organizations worldwide use GRI standards to ensure their disclosures meet global expectations.[130]

These initiatives play a critical role in harmonizing ESG reporting across borders and providing companies with a benchmark for best practices.

The ISA has entered into 15-year contracts for the exploration for polymetallic nodules, polymetallic sulfides and cobalt-rich ferromanganese crusts in the deep seabed with 22 contractors to date.[131] The table below identifies each contractor, noting whether they are affiliated with publicly listed companies (and therefore subject to relevant stock exchange disclosure requirements), as well as whether they are originally based in countries that have enacted specific environmental disclosure laws potentially applicable to deep-sea mining operations.

Contractor	Related to Listed Company/Companies	Related to Country with Environmental Disclosure Laws
Interoceanmetal Joint Organization	X	Multinational consortium Sponsoring states (Poland, Russia)
JSC Yuzhmorgeologiya	X (indirectly state-owned by Russia)	Russia (environmental disclosure laws)
Government of the Public of Korea	X (government entity)	South Korea (environmental disclosure laws)
China Ocean Mineral Resources Research and Development Association	X (managed by China's Ministry of Natural Resources)	China (environmental disclosure laws)

[128] "GRI - The Reporting Landscape", accessed 16 April 2025, https://www.globalreporting.org/public-policy/the-reporting-landscape/.
[129] "GRI - GRI Standards English Language", accessed 16 April 2025, https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/.
[130] "GRI Standards and Reporting | GRI Explained | Workiva Carbon", accessed 16 April 2025, https://www.sustain.life/blog/gri-standards.
[131] International Seabed Authority. *Exploration Contracts*. Accessed May 20, 2025. https://www.isa.org.jm/exploration-contracts/.

Contractor	Related to Listed Company/Companies	Related to Country with Environmental Disclosure Laws
Deep Ocean Resources Development Co, Ltd. (DORD)	√ Mitsubishi Corporation (TSE: 8058), Sumitomo Corporation (TSE: 8053), Mitsui & Co. (TSE: 8031))	Japan (environmental reporting required by law for listed companies)
Institut français de recherche pour l'exploitation de la mer (IFREMER)	X (fully owned by French government)	France (environmental disclosure laws) and EU regulations
Government of India	X (government entity)	India (environmental disclosure laws)
Federal Institute for Geosciences and Natural Resources	X (German government agency)	Germany (environmental disclosure laws) and EU regulations
Nauru Ocean Resources Inc. (NORI)	√ The Metals Company (NASDAQ: TMC))	U.S. SEC rules
Tonga Offshore Mining Limited (TOML)	√ (The Metals Company (NASDAQ: TMC))	U.S. SEC rules
Global Sea Mineral Resources NV (GSR)	√ (DEME Group's major shareholder Ageas listed on Euronext Brussels)	Belgium (environmental disclosure laws for listed companies - Ageas) and EU regulations
Loke CCZ (*formerly UK Seabed Resources Ltd.*)	X	UK (environmental disclosure laws)
Marawa Research and Exploration Ltd.	√ (The Metals Company (NASDAQ: TMC))	U.S. SEC rules
Ocean Mineral Singapore Pte. Ltd.	√ (POSCO Holdings (KRX: 005490))	Singapore (environmental disclosure laws)
Cook Islands Investment Corporation	X (Cook Islands government)	Cook Islands (limited but may be influenced by New Zealand's reporting)

Contractor	Related to Listed Company/Companies	Related to Country with Environmental Disclosure Laws
China Minmetals Corporation	√ (China Minmetals Corporation, SSE: 601668)	China (environmental disclosure laws)
Beijing Pioneer Hi-Tech Development Corporation	√ (Beijing Hi-Tech Development Co., Ltd., SSE: 600206)	China (environmental disclosure laws)
Ministry of Natural Resources and Environment of the Russian Federation	X (government entity)	Russia (environmental disclosure laws)
Government of Poland	X (government entity)	Poland (environmental disclosure laws)
Japan Organization for Metals and Energy Security	X (government agency)	Japan (environmental disclosure laws)
Companhia de Pesquisa de Recursos Minerais S.A.	X (Brazilian government-owned)	Brazil (environmental disclosure laws)
Blue Minerals Jamaica Ltd	√ Anglo American plc (LSE: AAL)	Jamaica (environmental disclosure laws)

Of the 22 contractors identified in the table above, 50% are directly or indirectly related to publicly listed companies (e.g., DORD, NORI, TOML, GSR, Loke CCZ). These listed companies are often subject to specific environmental disclosure regulations, particularly related to ESG issues, as required by stock exchanges or securities regulations like the U.S. SEC rules. Examples of such companies include Nauru Ocean Resources Inc. (NORI), Tonga Offshore Mining Limited (TOML) and Marawa Research and Exploration Ltd. (Marawa).[132] These three contractors are under the same beneficial ownership of TMC, which is subject to the U.S. SEC rules, including climate-related disclosures under the SEC regulations. Also, Deep Ocean Resources Development Co. Ltd. (DORD) is linked to Mitsubishi (TSE: 8058)[133] and other listed corporations, requiring compliance with Japan's mandatory environmental reporting laws for listed companies.

[132] "NASDAQ_TMC_2022.Pdf", accessed 16 April 2025, https://www.annualreports.com/HostedData/AnnualReportArchive/t/NASDAQ_TMC_2022.pdf.

[133] *International Seabed Authority. Polymetallic Nodule Mining Technology: Proceedings of the Workshop Held in Chennai, India, 19–22 September 2023.* Kingston, Jamaica: International Seabed Authority, 2023. https://www.isa.org.jm/wp-content/uploads/2023/10/chennai-19sept-final.pdf.

As for the remaining non-listed contractors, while they are not affiliated with publicly traded companies, they are still subject to national environmental disclosure requirements. For example, the Institut français de recherche pour l'exploitation de la mer (IFREMER) is fully government-owned,[134] and thus subject to EU regulations which mandate comprehensive ESG disclosures for large companies. Contractors in India, Russia, and Brazil are also subject to similar domestic laws.

However, despite the presence of disclosure and reporting requirements at both the national and international levels, the actual disclosure practices among ISA contractors remain insufficient. None of them are required by the ISA to disclose their beneficiary ownership, and disclosure standards remain largely at the contractors' discretion. As a result, the ISA's environmental disclosure framework is far from uniform, with significant gaps in transparency and accountability. In the absence of clear, uniform ISA disclosure requirements, particularly concerning beneficial ownership and ESG issues, significant opacity remains. Even contractors subject to domestic legislation or stock exchange rules may be able to circumvent those obligations through complex corporate structures. As noted earlier in this chapter, this opacity has serious implications since it hinders public scrutiny and impedes effective prevention of, and redress for, potential harms caused by deep-sea mining activities.

This chapter will now turn to other key legal concerns arising from deep-sea mining: labor risks and potential liability under trade and investment law.

Labor Risks Behind Deep-sea Mining's Employment Rationale

Job creation plays an important role in shaping states' decisions on deep-sea mining. The industry is often portrayed as a potential source of quality employment opportunities for local populations in sponsoring states. In fact, the prospect of local job creation is invoked by deep-sea mining company executives as an argument when seeking contracts to operate within a state's EEZ or to secure sponsorship before the ISA for deep-sea mining activities in the Area.[135]

This section examines deep-sea mining operations' labor-related legal risks both in areas beyond national jurisdiction and within states' EEZs. It concludes that deep-sea mining activities may involve significant labor risks, including jurisdictional challenges that hinder the effective enforcement of labor laws in the high seas, as well as occupational health and safety concerns. These risks are inadequately addressed under the ISA's current draft regulations.

[134] Wikipedia contributors, "IFREMER," *Wikipedia*, last modified February 2025, https://en.wikipedia.org/wiki/IFREMER.
[135] Caleb Fotheringham, "Deep-Sea Mining 'great Opportunity' for Cook Islands - Exploration Company," RNZ, September 20, 2023, https://www.rnz.co.nz/international/pacific-news/498386/deep-sea-mining-great-opportunity-for-cook-islands-exploration-company.

Labor Rights Abuses and Jurisdictional Challenges in the High Seas

Deep-sea mining has been presented as a potential solution to some of the human rights concerns associated with land-based mining, particularly widespread labor abuses such as forced and child labor.[136] Proponents argue that the extreme depths and technical challenges of accessing deep-sea mineral deposits would prevent the emergence of small, unregulated mining operations, making it easier to enforce strict labor standards. Unlike terrestrial mining, where artisanal and informal operations often evade oversight, deep-sea mining could be conducted exclusively by large-scale, regulated entities, theoretically allowing for greater control over labor conditions.[137] However, historical and contemporary examples from other industries operating in remote maritime environments suggest that the reality may be far more complex.

The fishing industry in the high seas illustrates the challenges of enforcing labor rights in remote maritime environments. Distant-water fishing operations have been plagued by labor abuses, including forced labor, human trafficking, and exploitative working conditions, often enabled by a lack of regulatory oversight and limited enforcement mechanisms.[138] The vast and fragmented nature of international maritime law creates jurisdictional gaps that allow these abuses to persist. If deep-sea mining follows a similar pattern, workers could face dangerous conditions with limited recourse for labor violations, particularly if companies operate under flags of convenience, meaning a company's ship is registered in a country with lenient labor standards regardless of the shipowner' home state, or exploit the jurisdictional ambiguities of the high seas to avoid stringent regulations.

The difficulty of enforcing human rights protections at sea largely stems from the complex interaction between maritime law and human rights law. While international human rights treaties apply universally, including at sea, their enforcement is often hindered by the structure of the international law of the sea. The jurisdictional framework established by UNCLOS creates a patchwork of governance zones that do not always align with human rights obligations, making

[136] Oliver Ashford et al., "What We Know About Deep-Sea Mining — and What We Don't," February 23, 2024, https://www.wri.org/insights/deep-sea-mining-explained.
[137] Ashford et al.; U. S. Government Accountability Office, "Deep-Sea Mining Could Help Meet Demand for Critical Minerals, But Also Comes with Serious Obstacles | U.S. GAO," September 12, 2024, https://www.gao.gov/blog/deep-sea-mining-could-help-meet-demand-critical-minerals%2C-also-comes-serious-obstacles.
[138] Elizabeth R. Selig et al., "Revealing Global Risks of Labor Abuse and Illegal, Unreported, and Unregulated Fishing," Nature Communications 13, no. 1 (April 5, 2022): 1612, https://doi.org/10.1038/s41467-022-28916-2.

it unclear which state is responsible for addressing labor abuses.[139] Some commentators have noted that both the law of the sea and human rights law have historically been "blind" to one another, fostering an enforcement vacuum that bad actors can exploit.[140] Without robust, enforceable mechanisms to protect workers, deep-sea mining risks replicating the same labor rights violations seen in other maritime industries, undermining the argument that it will necessarily improve labor conditions compared to land-based mining.

The ISA has the potential to clarify and strengthen the labor rights framework for deep-sea mining operations through its regulatory powers. However, the latest draft ISA regulations for exploitation provide minimal engagement with labor rights.[141] Specifically:

Regulation No. 30 on "Safety, Labour, and Health Standards" merely requires contractors to comply with the relevant national laws of their flag state for vessels or their sponsoring state(s) for installations. It further states that contractors must adhere to the national laws of their sponsoring state(s) regarding worker rights for non-crew members and health and safety issues related to mining rather than ship operations.

Regulation No. 38 mandates that contractors submit an annual report on compliance with health, labor, and safety conditions, while **Regulation No. 94** tasks an ISA commission with making recommendations on standards for protecting human health, safety, and labor matters.

These provisions are vague, simply mention labor rights in passing, and do not outline any concrete standard. As explained above, relying on flag or sponsoring state jurisdiction for labor matters has led to legal and enforcement gaps in other high-seas contexts. Given these precedents, there is reason to doubt that the current draft regulations provide sufficient safeguards for labor rights.

In sum, existing legal frameworks governing labor rights and worker protections are likely inadequate to address potential violations arising from deep-sea mining activities given the significant jurisdictional challenges that hinder effective enforcement in the high seas. Absent effective enforcement mechanisms, deep-sea mining may replicate the labor rights abuses observed in other industries operating in remote maritime environments.

Deep-sea mining's Potential as a Source of "Quality" Local Jobs

While concerns regarding jurisdictional challenges are most acute in the context of deep-sea mining operations in the high seas, they are less prominent within a state's EEZ, where jurisdiction over labor matters is more straightforward. However, this does not necessarily mean that deep-sea mining in the EEZ will deliver quality, risk-free employment for local populations.

[139] Rebecca Strating, Sunil Rao, and Sallie Yea, "Human Rights at Sea: The Limits of Inter-State Cooperation in Addressing Forced Labour on Fishing Vessels," Marine Policy 159 (January 1, 2024): 105934, https://doi.org/10.1016/j.marpol.2023.105934.
[140] Strating, Rao, and Yea.
[141] "Draft Regulations on Exploitation of Mineral Resources in the Area," ISBA/29/C/CRP.1, February 16, 2024, accessed April 15, 2025, https://www.isa.org.jm/wp-content/uploads/2024/02/Consolidated_text.pdf.

In this regard, a useful parallel can be drawn with the oil and gas sector, where similar dynamics frequently play out. Despite being promoted to host states as a source of local employment, oil and gas projects often face significant barriers to meaningful local job creation. These include a mismatch between local skillsets and industry demands, high training costs, and a resulting overreliance on expatriate workers, which may be accompanied by disparities in pay between foreign and local workers.[142] In the absence of legislation or contractual obligations requiring the hiring of local talent, deep-sea mining operations may follow the same pattern, especially given the technical specialization required for deep sea engineering roles.

Further, even when local jobs are created, the working conditions associated with deep-sea mining raise additional concerns. Similar to offshore oil and gas platforms, deep-sea mining operations are likely to involve physically and psychologically demanding environments characterized by social isolation, confinement at sea, harsh weather conditions, and long or irregular shifts. These stressors increase occupational health and safety risks for workers and may significantly impact their well-being, highlighting the need for robust labor protections regardless of the zone of operation.[143]

Stressors associated with working in an isolated offshore environment are not the only occupational health and safety risks posed by deep-sea mining. A 2023 study published in *Scientific Reports* revealed that some polymetallic nodules collected on the deep-sea floor of the Clarion-Clipperton Zone in the Pacific contained significant levels of radioactive substances. Radiation concentrations on the surface of these nodules were often found to exceed current safety thresholds by up to a factor of 1,000. Exposure to such radiation may pose serious health risks to workers who inhale or ingest radioactive dust released from the nodules' surface, from fine particles during processing, or from gases emitted by nodules stored in enclosed environments. Improper handling of nodules therefore presents a serious occupational hazard.[144]

A subsequent study published in the *Journal of Hazardous Materials* reported lower potential radiological risks, indicating that proper management of exposure time, maintaining a safe distance from radioactive sources, and using appropriate protective equipment could

[142] Jack Pegram, Gioia Falcone, and Athanasios Kolios, "A Review of Job Role Localization in the Oil and Gas Industry," Energies 11, no. 10 (October 2018): 2779, https://doi.org/10.3390/en11102779.
[143] Valdo F. Rodrigues, Frida Marina Fischer, and Mozar J. Brito, "Shift Work at a Modern Offshore Drilling Rig," J Hum Ergol 30 (2001): 167–72.
[144] Jessica B. Volz et al., "Alpha Radiation from Polymetallic Nodules and Potential Health Risks from Deep-Sea Mining," Scientific Reports 13, no. 1 (May 17, 2023): 7985, https://doi.org/10.1038/s41598-023-33971-w.

significantly mitigate harm to workers. However, the authors called for further research, as the full extent of health risks remains uncertain. They also noted that discrepancies in measured activity concentrations might result, among other factors, from geographical differences in sample collection sites.[145] What remains clear is that the potential for worker exposure to radioactive materials presents a significant concern that has not been fully assessed. Any regulatory framework for deep-sea mining must address these occupational health risks by implementing robust protective measures for workers involved in the processing, storage, and transportation of polymetallic nodules. As discussed above, the current ISA regulations fall short in adequately addressing such workers' rights and protections.

In light of these concerns, the promise that deep-sea mining will deliver high-quality jobs remains uncertain. While deep-sea mining is framed as an opportunity to improve labor conditions compared to terrestrial mining and to generate employment for local populations, the structural realities of working at sea, jurisdictional ambiguities, and parallels with other sectors suggest otherwise. Without clear and enforceable labor standards, particularly in the high seas, deep-sea mining risks reproducing the labor rights challenges seen in other offshore industries. Even within EEZs, the barriers to local employment, reliance on expatriate labor, and harsh working conditions raise doubts about whether deep-sea mining can live up to its job creation promises. Additionally, emerging evidence about the potential radiological hazards linked to the handling of polymetallic nodules adds a new layer of concern. Current regulations, including those developed by the ISA, remain insufficient to address these dangers.

Legal Liability Under Trade and Investment Law

States considering the facilitation of deep-sea mining should be aware of the potential risk of costly investment disputes, which could impact their ability to regulate potential environmental impacts of the industry. If French Polynesia or other Pacific states decide to embark on deep-sea mining exploration or exploitation, any subsequent necessary shifts in environmental or other policies could generate significant financial risks, as a result of exposure to investment claims by mining investors. Past arbitral awards involving such claims in the land mining sector have resulted in state liability running in the hundreds of millions to billions of U.S. dollars. This risk could also result in states being locked in to deep-sea mining, even if new risks or downsides are later discovered.

[145] Agnieszka Dołhańczuk-Śródka et al., "Assessment of Natural Radioactivity Levels in Polymetallic Nodules and Potential Health Risks from Deep-Sea Mining," Journal of Hazardous Materials 480 (December 5, 2024): 136494, https://doi.org/10.1016/j.jhazmat.2024.136494.

Specific risks arise in the context of deep-sea mining due to the substantial uncertainties that remain about deep-sea mining's impact on the environment. If these risks cannot be accurately quantified, they also cannot be appropriately allocated. In this context, mechanisms such as investment-state dispute settlements (ISDS) and contractual arrangements may open the door to litigation. International investment law and the ISDS system as it currently exists may not be well adapted to deep-sea mining. French Polynesia should ensure that it does not agree to arrangements where it would shoulder the burden of uncertainty-related risks. It should also be alive to the possibility that its neighbours may face the risks set out below with potential flow-on impacts for environmental regulation and protection in the Pacific.

Nature of the risk

There is increasing focus on state exposure to bilateral and multilateral investment agreements arising from state actions that seek to protect their citizens and the environment from potentially harmful corporate activities.[146] These risks stem from settlement mechanisms contained in international investment agreements such as Bilateral Investment Treaties (BITs) and the investment chapters of Free Trade Agreements (FTAs). These mechanisms allow international investors, including multinational enterprises, to sue governments for measures that are alleged to undermine their actual or expected profitability.[147]

Such dispute mechanisms are meant to be used as a last resort where a state acts in bad faith, such as engaging in uncompensated nationalisations, expropriations, or other illegal takings of investors' in-country investments. However, an increasing critique is that ISDS can be leveraged to challenge state measures adopted in good faith, including measures taken in the public interest for environmental reasons.[148]

Key elements of the risk

Reputational Risks

Investor-state disputes can entail reputational risks. Claims against host states under investor dispute mechanisms often include allegations that the host state has violated international law, which is a serious charge and could weaken confidence of other actors seeking to make investments in the host state.[149]

Removal of Proceedings to International Arbitration

One of the key features of investor-state disputes is the ability for investors to bring claims against host states in private international arbitration forums (i.e., outside of the state's domestic courts). In such forums, tribunals are composed of private individuals appointed by the parties to

[146] Lisa Sachs, Lise Johnson, and Ella Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment," January 1, 2020, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3531256, p90.
[147] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p90.
[148] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p91.
[149] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p92.

resolve the dispute.[150] These private tribunals have jurisdiction to determine disputes and may not be required to consider the host states' rights, policies or obligations under domestic and international law. Critics of ISDS argue that in the most extreme examples, private tribunals, composed of private adjudicators, wield decision-making power that can affect host state rights and policies, as well as the rights of non-litigant third parties, such as local communities.[151] This may limit the consideration of local concerns related to environmental and livelihood risks when deciding whether projects should proceed.[152]

Risks to the Ability to Pass or Enforce Laws for Environmental Protection

Investor state disputes can undermine Environmental Impact Assessment (EIA) processes, stakeholder participation regulations, and environmental decision-making processes.[153] States could also be pressured to withdraw otherwise legitimate regulatory or other action vis-à-vis mining activities within their territory, for fear of liability arising from investment claims. In fact, states may be sued after implementing environmental legislation, consultation processes or denying a permit or authorisation to proceed with mining. This can occur even in contexts where no EIA process has been conducted. States may be pressured to settle proceedings by reversing decisions to deny authorization, or by removing laws and regulation that was intended to protect the public interest. Several examples of where this has occurred are set out in the table below.

Table 1: Claims and Awards (in USD)

Nation	Amount Claimed	Amount Awarded	Reasons
Pakistan[154]	$8.5 billion in damages	$4 billion for lost future profits plus interest (with costs $5.976 billion)	Case concerned the rejection of a mining lease by Pakistan. Mining companies awarded future costs and interest despite lack of approved EIA. EIS process rendered irrelevant.
Ecuador[155]	$3.37 billion	$1.77 billion (reduced to $1.06 billion)	Ecuador terminated Occidental's oil contract for alleged breach tied to contractual concerns (and also environmental concerns).
Peru[156]	$522 million	$18.2 million in damages plus interest	Concerned revocation of mining decree after significant protests. Company awarded sunk costs despite lack of approved EIA.

[150] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p91.
[151] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p91.
[152] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p91.
[153] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p91, citing *Mobil and Murphy v. Canada (I),* Case No. ARB(AF)/07/4 (ICSID. 2007).
[154] *Tethyan Copper v. Pakistan*, ICSID Case No. ARB/12/1.
[155] *Occidental v Ecuador,* ICSID Case No. ARB/06/11.
[156] *Bear Creek Mining v. Peru*, ICSID Case No. ARB/14/21.

Nation	Amount Claimed	Amount Awarded	Reasons
Costa Rica[157]	$41 million	$16.06 million plus compound interest ($20 million total)	Concerned the purchase of land to develop a resort. Costa Rica expropriated the land to create a national park, citing environmental and public interest grounds, delay in payment of compensation.
Ecuador[158]	$69.7 million	$24 million in damages ($19.4 million after legal costs deducted)	Concerned actions by Ecuador to revoke concession licences after the mining company hired armed guards who fired on community members. Company awarded sunk costs despite lack of approved EIA. Tribunal found that Ecuador should have quashed protests rather than cancel concessions.
Mexico[159]	$90 million	$16million in damages plus interest	Refusal of landfill permit due to environmental concerns.
Romania[160]	$4.4 billion in damages (approx. 2% of Romanian GDP)	Dismissed	Permit for gold and silver mine denied due to concerns about cyanide poisoning.
Canada[161]	$100 million	Dismissed	Imposition of a moratorium on fracking due to concerns about impacts on water sources.

Several of the claims above resulted in awards that were significantly smaller than the original amount claimed. Two claims were ultimately dismissed on the basis that the environmental regulations were appropriate public policy. However, the awards remained substantial in many cases, and the legal costs of the states involved were up to and in excess of USD $10 million. These outcomes, and the fact that the initial claims were for substantial amounts, demonstrate the pressure that states may experience to settle matters by pulling back on environmental regulation and decision making.

This risk is particularly material when host states implement a policy change after initially supporting an industry. Two examples illustrate this risk:

[157] *Compañia del Desarrollo de Santa Elena S.A. v. Republic of Costa Rica*, ICSID Case No. ARB/96/1.
[158] *Copper Mesa Mining Corp. v Ecuador*, PCA Case No. 2012-02, Award, March 15, 2016 (awarding sunk costs notwithstanding the lack of an approved EIA).
[159] *Metalclad v Mexico,* ICSID Case No. ARB(AF)/97/1.
[160] *Gabriel Resources v. Romania*, ICSID Case No. RB/15/31.
[161] *Lone Pine v. Canada, Case No.* ICSID, UNCT/15/2.

Sweden: Sweden took a decision to cease exploration and exploitation permits for Uranium mining, citing the environmental impacts of uranium exploitation and the availability of other sources of energy. A mining company operating in Sweden brought a claim against Sweden under the Energy Charter Treaty (a multilateral FTA) on the basis that the treaty protected investors from a change in policy.[162] Sweden ultimately reversed course and has once again permitted Uranium mining.[163]

Guatemala: The threat of ISDS disputes also had significant impacts in Guatemala in relation to a proposed gold mine where Indigenous communities located nearby raised concerns about the mine's potential impact on the environment and their community. While Guatemala's President initially suspended operations, they were later restarted, reportedly on the basis of the threat of ISDS.[164]

The ability for states to be able to change position is particularly important for deep sea mining. In fact, significant scientific uncertainty remains about the deep seabed in a context where the technology involved in extraction is still developing, and the techniques that may ultimately be used, as well as their environmental impacts, are still unknown. A change in policy may be necessary to respond as research about the deep seabed and environmental baseline information become available to inform environmental regulation and decision-making.

Experts at Columbia University, such as Lisa Sachs, have criticized the power that investment treaties give over national policy, calling these rights "extraordinary."[165] They argue that states' environmental decision-making and policy "especially in relation to extractive projects, should also be allowed to change with evolving environmental standards and norms."[166]

Inability to Pass or Enforce Laws Ensuring that Mining Benefits a State's Citizens

In some circumstances, ISDS may also prevent states from adopting measures to ensure that the socio-economic gains from mining projects warrant the consumption of exhaustible natural resources and the associated environmental impacts. This could significantly impair host states from taking steps to ensure that deep sea mining is in the long-term economic interest of the communities that may be impacted by deep-sea mining. It could affect steps aimed at

For example, in ***Mobil and Murphy v. Canada (I)***,[167] investors successfully challenged efforts by Canada to ensure that an oil company invested in a minimum amount of education, training and research to ensure the project contributed to the long-term development of a low-income region, on the basis that this breached NAFTA.[168]

[162] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p97.
[163] "Sweden Moves to Lift Uranium Mining Ban," World Nuclear News, https://www.world-nuclear-news.org/articles/sweden-moves-to-lift-uranium-mining-ban.
[164] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p99.
[165] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p98.
[166] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p98.
[167] Mobil and Murphy v. Canada (I)Case No. ARB(AF)/07/04 (ICSID. 2007)
[168] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p97.

addressing the risks outlined above in section 1 (economic risks), including steps to offset the risk of boom-bust cycle and steps to use comprehensive cost-benefit analysis in decision-making about whether mining should proceed.

States Could Potentially be Locked into Deep-sea Mining and Assume its Risks

International investment law could act to "lock in" deep-sea mining in situations where states receive international investment for mining to be pursued. This is a significant risk in a context where deep-sea mining interacts with ecosystems that are fragile, unique and yet to be fully understood.[169]

Further, mining companies may leverage ISDS to offset the risks of future stranding of assets in the event that science advances and new concerns about deep-sea mining arise.[170] This would mean that host or sponsoring states are effectively the ones shouldering the burden of deep-sea mining's risks and uncertainties. Additionally, if companies feel confident that nation states, rather than corporate actors, will bear the risk of any new scientific discoveries that could justify reconsidering mining, this may also encourage an industry that might otherwise be too expensive and risky. In the worst-case scenario, investment disputes may result in awards to an investor of funds that they were not otherwise entitled to, for projects that had not yet gone through environmental approval processes.[171]

Corporations could organize their corporate structure to ensure they have the option to bring claims under BITs that are the most favourable to their position and offer the least protection for states seeking to impose environmental policy.

Risks Associated with Deep-sea mining Operations Within a Nation's EEZ

How Could These Risks Materialise in French Polynesia?

France has signed over 100 BITs and has one of the largest BIT networks in the world.[172] This could create a considerable risk of exposure to ISDS in the context of deep-sea mining in the event that they apply to French Polynesia as an overseas territory. This is likely to depend in part on the terms of the treaty in question. For example, the BIT signed between France and Colombia specifically state that it applies to French territory that includes "the european and overseas departments of the French Republic, including their territorial seas and surrounding zones in which France has sovereign rights of exploration and exploitation of natural resources of the seafloor, subsoil and waters above."[173] The inclusion of this language in the terms of the

[169] Alberto Pecoraro, "UNCLOS and Investor Claims for Deep Seabed Mining in the Area: An Investment Law of the Sea?," GCILS Working Paper Series, November 2020, https://gcils.org/wp-content/uploads/2020/11/GCILS-WP-2020-Paper-5-Pecoraro-Revised.pdf, citing, generally: Laura Kaikkonen et al, "Assessing the Impacts of Seabed Mineral Extraction in the Deep Sea and Coastal Marine Environments: Current Methods and Recommendations for Environmental Risk Assessment' (2018) 135 Marine Pollution Bulletin 1183.
[170] See: Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p94-95 (discussing climate change rather than deep-sea mining).
[171] Sachs, Johnson, and Merrill, "Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment", p97.
[172] "France | International Investment Agreements Navigator | UNCTAD Investment Policy Hub," n.d., https://investmentpolicy.unctad.org/international-investment-agreements/countries/72/france.
[173] Traités bilatéraux d'investissement: France/Colombie du 10 juill. 2014, art. 1, § 4.

treaty means that resolving the treaty's application may hinge on the resolution of the delineation of competence.

It is likely that companies seeking to bring French Polynesia within the jurisdiction of a favourable BIT would argue that French Polynesia is covered by this definition, exploiting any ambiguity in the delineation of competence. Accordingly, the risk of ISDS disputes relating to deep-sea mining could be significant for French Polynesia (noting as set out below that while there may be some possible steps that could be taken to mitigate this risk, it would prove difficult).

How Could These Risks Materialise for Neighbouring States?

Pacific states that are party to BITs or FTAs which include investment protection provisions could be exposed to the risks outlined above. As indicated in the table below, many Pacific states are parties to the PACER Plus and PICTA agreements. However, neither of these multilateral agreements include investment protection provisions.

Table 2: Treaties signed by Pacific Nations that have investment provisions

Treaty	Signatories	Relevant provisions
PACER Plus	Australia, New Zealand, Cook Islands, Kiribati, Nauru, Niue, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu and Fiji	Includes provisions to facilitate investment. However, it does not include traditional investment protections (i.e., expropriation, full protection and security, etc.). Focused on facilitation rather than protection. No ISDS: disputes are to be settled through domestic courts.
PICTA	Cook Islands, Fiji, Kiribati, Micronesia, Nauru, Niue, PNG, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu	Limited investment provisions, does not include ISDS jurisdiction.

Pacific states that have signed BITs with other countries are set out in Table 3 below.

In assessing the risk to French Polynesia of potential transboundary harm resulting from a neighbouring country's lack of environmental regulation the most relevant states are those with EEZ borders that are contiguous or located near French Polynesia, such as the Cook Islands, Kiribati, Pitcairn, Samoa, Tonga, Niue and Tokelau. Tonga has a BIT with the UK that includes traditional investment protections. This gives rise to a potential risk that a mining company structure itself such that it could rely on the UK BIT to protect its investment.

There are some countries such as Niue, Pitcairn (and also French Polynesia) that may be subject to BITs signed by New Zealand, the UK and France respectively, but only in the event that investment protection extends in each case to territories. Several Pacific states have not entered into any BITs that may give rise to an ISDS.

Table 3: Application of BITs to Pacific Countries

Treaty	Signatories	Relevant provisions
Cook Islands	No BITS or ICSID membership Has a strategic partnership with China	Partnership with China is relevant geopolitically, but does not contain traditional investment protection provisions.
Kiribati	Has signed no BITs	NA
Vanuatu	With China and the UK	Contains traditional investment protection provisions. ISDA availability
PNG	With Australia, Germany, China, the UK Signed by not ratified with Malaysia.	Contains traditional investment protection provisions ISDA availability.
Solomon Islands	Has signed no BITS	NA
Niue and Tokelau (NZ)	Subject to any the NZ has signed should these apply to territories – appears that they are not currently extended	NA
Pitcairn (UK)	Only if extended to Pitcairn as a territory of the UK	NA
Tonga	UK	Contains traditional investment protection provisions ISDA availability.
Fiji	Trade agreements with the US and Australia	NA
Tuvalu	Has signed no BITs	NA
Nauru	Has signed no BITs	NA
Palau	Has signed no BITs, but has a compact with the US that does provide some economic guarantees	NA

Treaty	Signatories	Relevant provisions
Marshall Islands	Has an agreement with Taiwan	NA
Samoa	Has signed no BITSK	NA

Can these risks be mitigated?

The relatively low number of BITs currently signed in the Pacific presents French Polynesia and other specific states with opportunities to protect themselves from the potential risks of ISDS, as set out above. Should interest in deep-sea mining in the region increase, states can take the following steps, depending on their circumstances:

- States that have not yet signed BITs or FTAs that contain investment protection provisions should consider the potential risks of doing so, including the specific risks associated with ISDS in the deep-sea mining context due to the uncertainty of the industry.
- States that have already signed BITs should assess their degree of exposure under the BITs currently in force and consider whether it may be necessary to negotiate an amendment to the BIT to address the specific circumstances of deep-sea mining.
- In both cases, this should be at an early stage and prior to any engagement with mining companies, the signing of agreements, or the issue of concessions or leases.

States that have signed BITs could also seek to negotiate exceptions and "opt outs" in any subsequent agreements regarding deep-sea mining specifically. However, mining companies would likely make a strong argument in the event of a dispute that it is not possible to derogate from or waive provisions of a BIT through contractual agreement. Thus, the legal status of such provisions would be vulnerable to challenge if they contradict provisions of BITs that are in force.

It should be noted that similar risks to those set out above with respect to ISDS may also arise in relation to contractual agreements between states and mining companies, including, for example, agreements conferring mining concessions or leases to companies. While a detailed consideration of these risks is beyond the scope of this analysis, given the specific uncertainties associated with deep-sea mining outlined above, states should be careful to ensure that there are contractual provisions that will permit them to respond to what may be a changing landscape as new information about the deep-sea environments and the impacts of deep-sea mining become available. Contractual provisions outlining conditions for termination, and the consequences that flow from them should receive particular attention.

Contractual agreements are, at their core, documents that allocate risks between parties. It is extremely difficult to allocate risks when the risks themselves are unable, at the present time, to be quantified. This creates significant risks for states entering into contractual arrangements with companies engaged in deep-sea mining, which will need to be carefully navigated.

Legal Risks Associated with Acting as a Sponsoring State Within the ISA Regime

Risks could also arise for states considering acting as a sponsoring state for exploration and exploitation within the ISA framework. If a state terminates state sponsorship, the contractor's foreign shareholder may seek compensation through international arbitration under an investment treaty applicable between the home state and the sponsoring state.[174] The claimant might argue that the termination of sponsorship is an unlawful expropriation prohibited by the investment treaty and customary international law.[175]

TMC's subsidiary, Nauru Ocean Resources, has recently invoked the concept of "legitimate expectations" taken from international investment law, in correspondence with the ISA in which they cite the $2 billion that they assert they have invested in deep sea mining and the "prolonged delay" by the ISA in adopting a mining code.[176] TMC thus appears to be raising the prospect of legal action in the event that the ISA takes steps that may frustrate its acquisition of an exploration license. Legal scholars doubt that the ISA, a multilateral body, could be sued pursuant to a doctrine of legitimate expectations.[177] However, the position could be very different for states that act as sponsors for deep-sea mining contractors under the ISA scheme.

The risk of investor-state disputes may substantially undermine the ability of French Polynesia and other states to impose environmental laws and regulations concerning deep sea mining, and to design approval processes that allow for community consultation. This risk is particularly material where policy changes may take place, which is particularly concerning given the current lack of knowledge about the deep seabed and the potential consequences of mining it.

Conclusion

Deep-sea mining is often presented to Pacific nations as a pathway to economic development. Yet, engaging in deep-sea mining, whether within a state's EEZ or through sponsorship under the

[174] Pecoraro, Alberto, 'Law of the Sea and Investment Protection in Deep Seabed Mining' [2019] MelbJlIntLaw 19; (2019) 20(2) Melbourne Journal of International Law (generally).
[175] Pecoraro, Alberto, 'Law of the Sea and Investment Protection in Deep Seabed Mining' [2019] MelbJlIntLaw 19; (2019) 20(2) Melbourne Journal of International Law p534.
[176] AFP - Agence France Presse, "Companies Slam Delay on Deep-sea Mining Rules," Barrons, January 18, 2025, https://www.barrons.com/news/companies-slam-delay-on-deep-sea-mining-rules-cdc06c14.
[177] Alberto Pecoraro, Hannah Lily, and Pradeep Singh, "The International Seabed Authority and the Push for Exploitation of Deep Seabed Minerals: Does the Doctrine of Legitimate Expectations Apply?," The Journal of World Investment & Trade 25, no. 5–6 (November 22, 2024): 698–741, https://doi.org/10.1163/22119000-12340344.

ISA framework, exposes states to serious economic and legal risks. These include unstable markets, uncertain returns, unclear accountability for environmental harm (compounded by integrity concerns within the ISA and inadequate corporate disclosures among ISA contractors), harsh labor conditions, and possible financial liability from investor-state disputes. These factors, combined with various social and environmental costs associated with deep-sea mining raise real questions as to whether it will generate substantial revenue, and whether these revenues will be sufficient to justify the drawbacks that it could have on other parts of French Polynesia's economy.

Chapter 2. Environmental Risks: Review of Scientific Developments and the Relationship to Deep Sea Mining

Proponents of deep-sea mining portray it as a cleaner alternative to terrestrial mining. However, mounting scientific evidence shows this is implausible and in many cases unverifiable given the current state of scientific understanding. The discovery in 2024 of a potential source of "dark oxygen" demonstrates how little we know about the environments of the deep sea.

This chapter summarizes the known environmental, social, cultural, and governance impacts of deep-sea mining, challenging the perception of its environmental cleanliness. A special focus is given to the human rights implications of deep-sea mining's potential environmental harms. This chapter also describes the gaps in scientific knowledge about deep seabed environments, as well as the limits of monitoring and enforcement given the conditions of the deep sea.

2.1 What is Being Mined?

Critical mineral deposits on the deep-sea floor broadly fit into three categories:

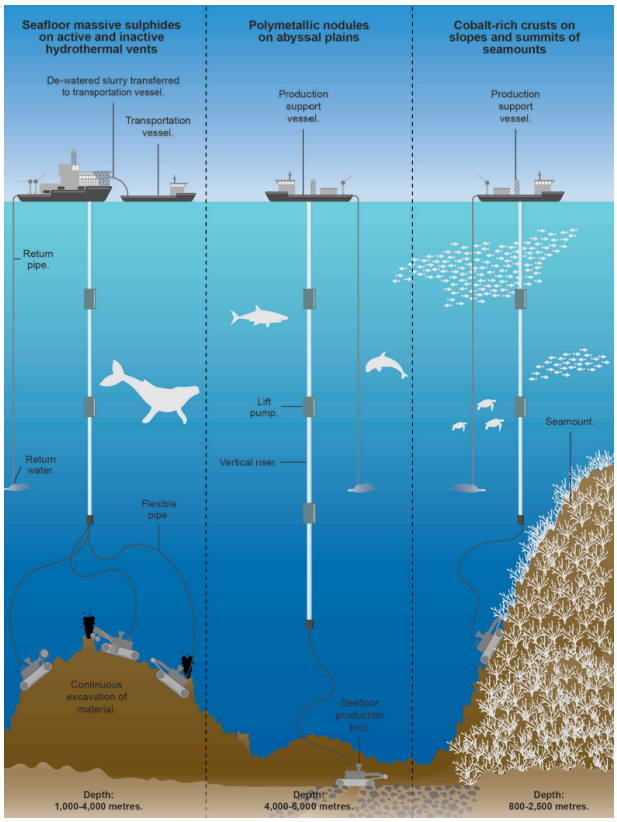
1. **Crusts**: Cobalt-rich deposits fixed to underwater ridges and seamounts
2. **Hydrothermal vents**: Hot, metal-rich fluids discharge from beneath the seabed and accumulate to form deposits
3. **Nodules**: Unattached potato-sized polymetallic deposits, scattered across the seabed at depths of 4,000 to 6,000 metres.

Of the three deposit types, nodules are most likely to be exploited in French Polynesia and neighboring EEZs for two reasons: their abundance in the Clarion-Clipperton Zone (CCZ) and the greater technical challenges associated with mining vents and seamounts.[178]

The process of deep-sea mining for nodules involves various methods, including dredging, Autonomous/Remote-operated vehicles, and subsea drilling. Dredging entails the use of a large, underwater machine to suck up sediment from the ocean floor and pump it to the surface for processing. ROVs act as a vacuum cleaner to "suck" the nodules up through a pipeline to the

[178] Kathryn A. Miller et al., "An Overview of Seabed Mining Including the Current State of Development, Environmental Impacts, and Knowledge Gaps," *Frontiers in Marine Science* 4 (January 10, 2018), https://doi.org/10.3389/fmars.2017.00418.

surface. Subsea drilling involves drilling into the ocean floor to access minerals beneath the surface; this is used less for nodule mining. A key issue that came up in interviews with scientists is the lack of information about the actual techniques that will be used at commercial scale.



French Polynesia's Exclusive Economic Zone lies within the CCZ. The CCZ has an area of 6 million square kilometers and an average depth of 5,500 meters. Research on the CCZ, and the ecosystems, animals, and organisms that inhabit it, has only recently commenced in earnest. The deep sea was once thought to be devoid of life. However, hundreds of species in the CCZ have been discovered in the last 15 years, and researchers estimate that there are thousands more remaining undiscovered.[179] Examples include thousands of species of worms, arthopoda and starfish, as well as more than 20 species of dolphins and whales. It is now considered the largest habitable space on Earth, with estimates ranging from tens of thousands to millions of species yet to be discovered.[180]

Scientists have very limited knowledge about the ecosystems of the deep sea, and therefore the impact that mining can have. Baseline biodiversity knowledge of the region is crucial to effective management of environmental impact from potential deep-sea mining activities, but such information has been almost completely lacking until recently.[181] For example, in one study interviewing scientists, 88 percent of experts agreed that current scientific knowledge is too sparse to ensure the protection of the marine environment from impacts of deep-sea mining, while 90 percent of experts estimated it would take between 6 to 20 years to build the scientific knowledge needed to properly protect the marine environment from deep-sea mining.[182] In the CCZ, 85 percent of the scientific topics assessed were dominated by knowledge gaps or had no knowledge. This quote is typical of the literature:

[179] Muriel Rabone et al., "How Many Metazoan Species Live in the World's Largest Mineral Exploration Region?," *Current Biology* 33, no. 12 (June 19, 2023): 2383-2396.e5, https://doi.org/10.1016/j.cub.2023.04.052.
[180]Stefanie Kaiser et al., "Diving through the Darkness; Species Information Is Vital for Effective Marine Conservation," December 6, 2022, https://doi.org/10.5281/zenodo.7410159.
[181] Muriel Rabone et al., "How Many Metazoan Species Live in the World's Largest Mineral Exploration Region?," *Current Biology* 33, no. 12 (June 19, 2023): 2383-2396.e5, https://doi.org/10.1016/j.cub.2023.04.052.
[182] Diva J. Amon et al., "Assessment of Scientific Gaps Related to the Effective Environmental Management of Deep-Seabed Mining," *Marine Policy* 138 (April 1, 2022): 105006, https://doi.org/10.1016/j.marpol.2022.105006.

> "Although substantial uncertainties and unknowns remain, it is likely that commercial extraction of marine minerals at any scale will have a negative impact on the local ecosystem and potentially further afield."[183]

The general consensus of marine ecologists who have published on this subject is that commercial extraction of minerals from the deep seabed would cause lasting and irreversible damage to fragile ecosystems.[184] The majority of species also remain unknown: biologists estimate that up to 75 percent of animal species are yet to be discovered in areas that have been sampled. Further, many species have only been collected once or twice, which is insufficient to draw sound conclusions on their ecological attributes (e.g., species abundance, diversity, ranges, relationships with other species, contribution to overall ecosystem function, extinction risks, and vulnerability to and recovery from deep-seabed mining). This aligns with what we heard in our first-hand interviews of scientists who specialize in deep-sea environments around the world, for example:

> "We need to have independent scientists doing the research. I have collaborated with a lot of companies like TMC [The Metals Company], Lockheed Martin etc. These companies bring in independent researchers but it's important that this data be published regardless of what the conclusions are. In terms of impact assessments, you need monitoring over many years not just a couple of years. We published a paper recently where we went back to a mining track 44 years later, and there were still signs of the impact. We need 5-10 years at least for these impact assessments [...]
>
> Another thing is that just because we see an animal near the site where mining has taken place, it just says that the animal is alive. How do we know that the animal, or a coral, has not been impacted genetically? We cannot just assume by the presence of the animal - we need further research. There are certain companies who do say that we have conducted an impact assessment and have been back to study it 1-2 times. We need to at least monitor it for 5-10 years if not 40 years."[185]

A key risk is that, because of the slow growth and recovery of deep-sea communities, impacts of sudden mining activities could have long-term consequences. One paper found significant uncertainties regarding baseline conditions, the impacts of mining activities (including plumes, noise, and toxicity), and ecosystem resilience.[186] The study emphasizes the urgent need for further research to inform robust environmental impact assessments, monitoring plans, and

[183] Kirsten F. Thompson et al. p2, "Urgent Assessment Needed to Evaluate Potential Impacts on Cetaceans from Deep Seabed Mining," *Frontiers in Marine Science* 10 (February 14, 2023), https://doi.org/10.3389/fmars.2023.1095930.
[184] Holly J. Niner et al., "Deep-Sea Mining With No Net Loss of Biodiversity—An Impossible Aim," *Frontiers in Marine Science* 5 (March 1, 2018), https://doi.org/10.3389/fmars.2018.00053.; Daniel O. B. Jones et al., "Biological Responses to Disturbance from Simulated Deep-Sea Polymetallic Nodule Mining," *PLOS ONE* 12, no. 2 (February 8, 2017): e0171750, https://doi.org/10.1371/journal.pone.0171750.
[185] Dr Andrew Sweetman, Interview, 31 March 2025.
[186] Diva J. Amon et al., "Assessment of Scientific Gaps Related to the Effective Environmental Management of Deep-Seabed Mining," *Marine Policy* 138 (April 1, 2022): 105006, https://doi.org/10.1016/j.marpol.2022.105006.

regulatory frameworks by the International Seabed Authority (ISA). Information on the ability of deep-sea ecosystems to resist or recover from mining impacts is limited for all three resource types. Understanding resilience requires robust baseline data and knowledge of mining impacts, tolerance thresholds, and tipping points. The following sections examine in greater detail different environmental risks and knowledge gaps warranting further research.

2.2 Environmental Risks and Impacts of Deep-sea Mining

Direct Physical Disturbance

Mining for polymetallic nodules significantly disturbs the seabed, resulting in permanent alterations of deep-sea habitats. The removal of nodules and the compaction of sediments destroys habitats critical to many deep-sea species.[187] For example, species that live on or around the nodules themselves include actiniarians (a genus of sea anemones); alcyonacean corals (commonly known as soft corals) and antipatharian corals (black or thorn corals); and glass sponges.[188] These structure-forming species can play an important role in creating habitats for other animals that depend on seafloor areas for part or all of their lifecycle. Recovery times for disturbed habitats range from decades to centuries to millennia due to extremely slow growth rates of nodules and associated biota; the disturbances are therefore effectively permanent at human timescales.[189]

Sediment Plumes

Deep-sea mining can generate large sediment plumes. These can be broken down into plumes from seafloor disturbance (collector plumes), and plumes from the disposal of dewatering sediment at different ocean depths (dewatering plumes). These plumes can disperse sediments over large areas, smothering and burying organisms and habitats.[190] Impacts extend beyond immediate mining areas, affecting marine life. Sediment in midwater plumes can travel across ocean mining sites, potentially affecting an area of several million square kilometers over the course of a 20-year mining operation.[191]

[187] Diva J. Amon et al., "Assessment of Scientific Gaps Related to the Effective Environmental Management of Deep-Seabed Mining," *Marine Policy* 138 (April 1, 2022): 105006, https://doi.org/10.1016/j.marpol.2022.105006.
[188] Ann Vanreusel et al., "Threatened by Mining, Polymetallic Nodules Are Required to Preserve Abyssal Epifauna," *Scientific Reports* 6, no. 1 (June 1, 2016): 26808, https://doi.org/10.1038/srep26808.
[189] Daniel. Jones et al., "Biological Responses to Disturbance from Simulated Deep-Sea Polymetallic Nodule Mining," *PLOS ONE* 12, no. 2 (February 8, 2017): e0171750, https://doi.org/10.1371/journal.pone.0171750.
[190] Carlos Muñoz-Royo et al., "Extent of Impact of Deep-Sea Nodule Mining Midwater Plumes Is Influenced by Sediment Loading, Turbulence and Thresholds," *Communications Earth & Environment* 2, no. 1 (July 27, 2021): 1–16, https://doi.org/10.1038/s43247-021-00213-8.
[191] Carlos Muñoz-Royo et al., "Extent of Impact of Deep-Sea Nodule Mining Midwater Plumes Is Influenced by Sediment Loading, Turbulence and Thresholds," *Communications Earth & Environment* 2, no. 1 (July 27, 2021): 1–16, https://doi.org/10.1038/s43247-021-00213-8.

Toxicological Impacts

Complex ecosystem interactions will also be affected, with potential toxicity from metals released during sediment disturbance posing significant ecological threats.[192] Mining polymetallic sulphides has a high potential for toxicity due to metals like copper and zinc. Toxic metals released during mining activities accumulate in marine organisms, potentially affecting fisheries and the wider marine food web. The full scale of bioaccumulation impacts is not yet well understood, highlighting an urgent need for ecotoxicological baselining studies.[193]

Noise, Light, and Vibration

Deep-sea ecosystems are typically quiet and dark environments. Deep-sea mining introduces substantial anthropogenic noise, artificial light, and vibrations to these environments. These disrupt the normal behavior and communication of deep-sea species. Species relying on natural acoustic signals for communication, navigation, and predator avoidance are particularly vulnerable.[194]

Cumulative Impacts

Cumulative effects from multiple mining operations compound impacts, with potential to exponentially degrade marine ecosystems. Deep-sea mining activities, combined with climate change, acidification, pollution, and fishing pressures, could push vulnerable ecosystems beyond recovery, adversely impacting global biodiversity and marine ecosystem services.[195]

The most significant environmental impact of deep-sea mining will likely be habitat loss due to the direct removal of mineral substrates from the ocean floor, although accurately predicting the scale and extent of damage to these fragile marine ecosystems remains extremely challenging.[196] While technological advances have enhanced ocean mapping capabilities and deepened our understanding of deep-sea biodiversity, ecosystem dynamics, and connectivity, substantial scientific uncertainties persist. A comprehensive global marine census concluded in 2010 estimated that only about 20 percent of marine species had been formally described, highlighting considerable knowledge gaps with which to baseline and measure impacts.[197] A precautionary approach to deep-sea mining activities should therefore be implemented until sufficient scientific baselines and robust monitoring frameworks are established.

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[192] Daniel. Jones et al., "Biological Responses to Disturbance from Simulated Deep-Sea Polymetallic Nodule Mining," *PLOS ONE* 12, no. 2 (February 8, 2017): e0171750, https://doi.org/10.1371/journal.pone.0171750.s.
[193] Daniel. Jones et al., "Biological Responses to Disturbance from Simulated Deep-Sea Polymetallic Nodule Mining," *PLOS ONE* 12, no. 2 (February 8, 2017): e0171750, https://doi.org/10.1371/journal.pone.0171750.s.
[194] Kathryn A. Miller et al., "An Overview of Seabed Mining Including the Current State of Development, Environmental Impacts, and Knowledge Gaps," *Frontiers in Marine Science* 4 (January 10, 2018), https://doi.org/10.3389/fmars.2017.00418.
[195] United Nations Environment Program, "Harmful Marine Extractives: Deep-Sea Mining," Briefing Paper, June 2022, https://www.unepfi.org/publications/harmful-marine-extractives-deep-sea-mining/.
[196] Kirsten F. Thompson et al., "Urgent Assessment Needed to Evaluate Potential Impacts on Cetaceans from Deep Seabed Mining," *Frontiers in Marine Science* 10 (February 14, 2023), https://doi.org/10.3389/fmars.2023.1095930.
[197] Mark John Costello et al., "A Census of Marine Biodiversity Knowledge, Resources, and Future Challenges," *PloS One* 5, no. 8 (August 2, 2010): e12110, https://doi.org/10.1371/journal.pone.0012110.

2.3 Scientific Baselines and Knowledge Gaps

A critical challenge in assessing deep-sea mining's environmental impacts is the scarcity of robust scientific baseline data. Even the best-studied regions, such as the CCZ, lack adequate data to support evidence-based environmental management. Estimates include up to 75 percent of species in targeted mining areas remain undiscovered. Further, ecosystems are poorly understood, with unknown ecological functions, connectivity patterns, and recovery potentials.[198] Two quotes establish the general sentiment of our interviews with scientists, succinctly establishing the scientific gap:

> "The deep sea is a very under explored environment because of its generally large distance away from land, difficulty in accessing it, and the cost in doing that as well."[199]
>
> "Right now, we don't even have the baseline criteria. I've looked at different data sets from different deep sea groups and tried to put them together. And it's just literally impossible, the data that they have are not comparable. So putting them together in the 1st place, will get you incorrect results. So we kind of all need to get on the same page as far as what we need to examine and how we're going to examine it."[200]

Addressing these gaps to establish effective environmental monitoring and management standards would require decades of intensive, internationally coordinated and funded research efforts.[201] Currently, ecological baselines for midwater ecosystems, crucial for understanding broader oceanic impacts, do not exist in regions under consideration for mining.[202] Another key issue in establishing baselining of impacts that was identified in our interviews was the lack of knowledge about the actual form of the techniques that will be used once deep-sea mining is performed at a commercial scale. This uncertainty compounds the difficulty of establishing causal impacts from baseline research. More information about the techniques used to mine the particular areas would also therefore be imperative for scientists to establish baselines.

The discovery of "dark oxygen" in 2024 illustrates just how limited our understanding of the deep-sea environment remains:

Dark Oxygen: A Recent, Revelatory Discovery for Future Research

A recent study published in *Nature Geoscience* has revealed the limits to what scientists know about environments and biodiversity on the Deep Seabed. The study theorizes how

[198] United Nations Environment Program, "Harmful Marine Extractives: Deep-Sea Mining," Briefing Paper, June 2022, https://www.unepfi.org/publications/harmful-marine-extractives-deep-sea-mining/.
[199] Dr Oliver Ashwell, Interview, 10 March 2025
[200] Dr Travis Washburn, Interview, 6 March 2025
[201] Diva J. Amon et al., "Assessment of Scientific Gaps Related to the Effective Environmental Management of Deep-Seabed Mining," *Marine Policy* 138 (April 1, 2022): 105006, https://doi.org/10.1016/j.marpol.2022.105006.
[202] United Nations Environment Program, "Harmful Marine Extractives: Deep-Sea Mining," Briefing Paper, June 2022, https://www.unepfi.org/publications/harmful-marine-extractives-deep-sea-mining/.

polymetallic nodules on the deep seafloor can possibly generate oxygen without sunlight, a phenomenon dubbed "dark oxygen." This discovery suggests that polymetallic nodules contribute actively to deep-sea ecosystems through previously unrecognized biochemical processes. Polymetallic nodules on the abyssal seafloor in the Pacific Ocean exhibited unexpected oxygen production under dark, high-pressure conditions. Experiments indicated that this oxygen generation may result from seawater electrolysis, driven by voltage potentials inherent to nodule chemistry.[203] Further research is necessary to verify and test these claims, which are still being debated, especially given the recency of the discovery. Regardless, the paper demonstrates the extent of activity that is still not understood by scientists.

Researchers studying oxygen levels in the CCZ initially set out to measure how much oxygen marine organisms were consuming. However, instead of seeing oxygen levels drop as expected, they observed a steady increase. After ruling out faulty equipment and biological sources, they determined that the nodules themselves were responsible. Their leading theory suggests that these nodules act as "natural batteries," developing an electrical charge over millions of years as different metals accumulate in layers. This charge may drive a process similar to electrolysis, splitting seawater into hydrogen and oxygen.[204]

More studies are needed to test how much oxygen these nodules naturally produce in the deep sea or whether it plays a significant role in supporting marine life. However, since many deep-sea species rely on these nodules as habitat, the findings add another dimension to the debate over deep-sea mining. Scientists emphasize the need for more research to fully understand the ecological impact of disturbing these mineral deposits. This raises urgent questions about how mining activities could disrupt these critical processes before scientists are able to measure them.

2.4 Human Rights Implications of Deep-Sea Mining's Environmental Risks

Deep-sea mining has the potential to cause significant harm to marine biodiversity and ecosystems,[205] which in turn can affect human rights and wellbeing, even when deep-sea mining activities seem distant from human populations. As identified in this chapter, an increasing number of marine scientists agree that deep-sea mining is likely to systematically deplete resources, damage key components of marine ecosystems, and lead to biodiversity loss.

The full extent of potential harm remains uncertain and difficult to predict due to our limited understanding of deep-sea marine life. It is also unclear whether and to what degree an

[203] Andrew K. Sweetman et al., "Evidence of Dark Oxygen Production at the Abyssal Seafloor," *Nature Geoscience* 17, no. 8 (August 2024): 737–39, https://doi.org/10.1038/s41561-024-01480-8.
[204] Andrew K. Sweetman et al., "Evidence of Dark Oxygen Production at the Abyssal Seafloor," *Nature Geoscience* 17, no. 8 (August 2024): 737–39, https://doi.org/10.1038/s41561-024-01480-8.
[205] C. L. Van Dover et al., "Biodiversity Loss from Deep-Sea Mining," *Nature Geoscience* 10, no. 7 (July 2017): 464–65, https://doi.org/10.1038/ngeo2983.

ecosystem can recover after mining operations end.[206] In parallel, there is a growing understanding and acknowledgment in international human rights law that biodiversity loss impacts a variety of human rights.[207] The UN General Assembly's resolution on the human right to a clean, healthy and sustainable environment expressly recognized that biodiversity loss threatens the effective enjoyment of "all human rights."[208]

This section identifies the internationally recognized human rights most likely to be adversely affected by deep-sea mining. It then assesses the adequacy of the current ISA regulatory framework in addressing these concerns, concluding that human rights risks remain insufficiently accounted for. While the focus here is on international legal regimes given the cross-jurisdictional nature of deep-sea mining's potential environmental impacts, it is important to note that domestic legal systems may also play a role in addressing human rights concerns, particularly where impacts are localized.

Human Rights Risks from Deep-sea Mining's Environmental Harms

While the impacts of deep-sea mining on marine ecosystems may affect all human rights, internationally recognized rights most directly at risk include the rights to health, food, life, and to a clean and healthy environment. In fact, marine biodiversity plays a crucial role in supporting these rights by providing food sources, contributing to the development of pharmaceutical products, producing atmospheric oxygen, and sequestering carbon from the atmosphere.[209] Given their interconnected nature, these rights are considered together in this section. For instance, the full realization of the rights to health and life depends on access to adequate food.

Turning to the specific ways in which deep-sea mining may affect these human rights, the first major concern is its impact on food sources, as it is expected to disrupt fish stocks throughout the entire water column. A peer-reviewed report from MiningWatch Canada set out the potential consequences for fisheries at various depths:

> **Ocean surface**: The physical presence of ships and support platforms, likely to cause surface discharges, noise and light pollution, may affect fish migrations.
>
> **Mid-water**: Pipes for the transportation of minerals to the ships, the vertical movement of mining vehicles, and the disposal of waste sediments (plumes), may disrupt fish stocks.

[206] Kirsten F. Thompson et al., "Seabed Mining and Approaches to Governance of the Deep Seabed," *Frontiers in Marine Science* 5 (December 11, 2018), https://doi.org/10.3389/fmars.2018.00480.
[207] Elisa Morgera and Hannah Lily, "Public Participation at the International Seabed Authority: An International Human Rights Law Analysis," *WILEY RECIEL*, 2022, https://doi.org/10.1111/reel.12472.
[208] "The Human Right to a Clean, Healthy and Sustainable Environment" (2022), United Nations General Assembly, Resolution 76/300, https://digitallibrary.un.org/record/3983329.
[209] European Marine Board, "Linking Oceans and Human Health," 23–59, accessed April 15, 2025, https://www.marineboard.eu/sites/marineboard.eu/files/public/publication/Oceans%20and%20Human%20Health-214.pdf.

Seafloor: Mining activities are likely to destroy habitats and ecosystems, generate sediment plumes, noise, and light pollution.[210]

Recent research further revealed a high degree of interconnectedness between marine ecosystems, both horizontally and vertically within the water column. This connectivity suggests that disruptions to marine biodiversity in remote areas can have far-reaching effects on coastal ecosystems and the human communities that rely on them.[211] Finally, the extraction of nodules could negatively affect the stability of marine food webs, as these nodules play a crucial role in maintaining ecosystem health and supporting abyssal plain food networks.[212]

Together, these disruptions across all levels of the water column may have far-reaching negative consequences for global fisheries, ultimately affecting food security. This impact would be particularly severe for coastal and Indigenous communities that rely on fish stocks as a vital source of nutrition.[213] In fact, exploratory deep-sea mining has already had negative effects on certain Pacific indigenous communities' food supply. In Tonga, deep-sea mining prospecting vessels have encroached on vital fishing areas, disrupting fish populations and obstructing traditional fishing routes. Meanwhile, in Papua New Guinea, villagers have reported an alarming increase in dead fish washing ashore, including unusual deep-sea species, along with a decline in water quality. Traditional fishing waters have also become increasingly murky and dusty, further impacting local livelihoods.[214]

A second major concern regarding deep-sea mining's impact on marine ecosystems is the potential rise in metal concentrations. Deep-sea mining is expected to release metals such as copper, lead, and zinc into the surrounding environment, which may be toxic to marine organisms and cause certain species to avoid areas with elevated metal levels. These effects

[210] Andrew Chin and Katelyn Hari, "Predicting the Impacts of Mining Deep Sea Polymetallic Nodules in the Pacific Ocean," 32, accessed April 15, 2025, https://www.miningwatch.ca/sites/default/files/nodule_mining_in_the_pacific_ocean.pdf.
[211] Graham J. Hamley, "The Implications of Seabed Mining in the Area for the Human Right to Health," *Review of European, Comparative & International Environmental Law* 31, no. 3 (2022): 390, https://doi.org/10.1111/reel.12471.
[212] Graham J. Hamley, "The Implications of Seabed Mining in the Area for the Human Right to Health," *Review of European, Comparative & International Environmental Law* 31, no. 3 (2022): 390-91, https://doi.org/10.1111/reel.12471.
[213] Graham J. Hamley, "The Implications of Seabed Mining in the Area for the Human Right to Health," *Review of European, Comparative & International Environmental Law* 31, no. 3 (2022): 390-91, https://doi.org/10.1111/reel.12471.
[214] Julie Hunter, Pradeep Singh, and Julian Aguon, "Broadening Common Heritage: Addressing Gaps in the Deep Sea Mining Regulatory Regime," *Harvard Environmental Law Review*, April 16, 2018, 3, https://www.researchgate.net/publication/326518886_Broadening_Common_Heritage_Addressing_Gaps_in_the_Deep_Sea_Mining_Regulatory_Regime.

would pose risks to human health and food, particularly through the accumulation of metals in marine food webs which could ultimately enter the human food chain.[215]

A third potentially harmful consequence of deep-sea mining is its impact on climate change. Given the ocean's vital role in regulating the global climate, seabed mining could accelerate climate change by disrupting carbon storage mechanisms. The ocean absorbs and retains vast amounts of carbon dioxide, with a significant portion sequestered in marine sediments on the seafloor, which is considered by some to be among the planet's most critical carbon reservoirs. Deep-sea mining activities would disturb these sediments, potentially releasing stored carbon back into the ocean and the atmosphere. If this occurs, it could intensify climate change, exacerbating its adverse effects on a wide range of human rights, including the rights to health and life. These impacts may manifest through increased exposure to extreme weather events and disruptions to food supplies, further endangering vulnerable communities.[216]

It is important for ISA member states to consider the potential human rights impacts of deep-sea mining, not only because these effects will directly impact their communities but also due to their obligations under international human rights law. For instance, the rights to food and health are legally binding under the International Covenant on Economic, Social and Cultural Rights, ratified by France and 160 other countries.[217] While economic, social, and cultural rights are subject to the principle of progressive realization, which allows states flexibility in how and when they achieve full implementation, certain "core" obligations remain non-derogable. Proceeding with deep-sea mining despite its uncertain yet likely harmful effects on these rights could constitute a breach of these core obligations.[218]

In short, deep-sea mining's potential impacts on marine ecosystems could have significant human rights implications. In particular, disruptions to food supplies and threats to health could disproportionately affect coastal and Indigenous communities that rely on marine resources for their well-being. Given the uncertainties around deep-sea mining's impacts on marine ecosystems and spillover effects on human communities, further research is needed to understand deep-sea mining's specific impacts on human rights.

[215] Graham J. Hamley, "The Implications of Seabed Mining in the Area for the Human Right to Health," *Review of European, Comparative & International Environmental Law* 31, no. 3 (2022): 391, https://doi.org/10.1111/reel.12471.
[216] Graham J. Hamley, "The Implications of Seabed Mining in the Area for the Human Right to Health," *Review of European, Comparative & International Environmental Law* 31, no. 3 (2022): 391, https://doi.org/10.1111/reel.12471.
[217] "International Covenant on Economic, Social and Cultural Rights", adopted December 16, 1966, *General Assembly resolution 2200A (XXI)*, https://www.ohchr.org/en/instruments-mechanisms/instruments/international-covenant-economic-social-and-cultural-rights.
[218] "Economic, Social and Cultural Rights," OHCHR, accessed April 15, 2025, https://www.ohchr.org/en/human-rights/economic-social-cultural-rights.

Insufficient Consideration of Human Rights in ISA Regulations

Given the significant human rights risks outlined above, it is critical that any applicable regulatory framework include robust mechanisms to address these risks and ensure effective remedies for affected communities or individuals. The current framework developed by the ISA falls short of providing such guarantees.

The International Regulatory Framework for Deep-sea Mining:

By way of background, the regulatory framework governing mining in the seabed and ocean floor beyond the limits of national jurisdiction (the Area) is established by the United Nations Convention on the Law of the Sea (UNCLOS)[219] and the Agreement Relating to the Implementation of Part XI of UNCLOS.[220] Under UNCLOS, the Area and its mineral resources are designated as the "common heritage of mankind," meaning that no state may unilaterally appropriate these resources, and all activities in the Area must benefit humankind as a whole. The ISA is the central regulatory body responsible for overseeing seabed mining in the Area. Its mandate includes organizing, controlling, and carrying out activities in the Area, while also ensuring the protection of the marine environment and promoting marine scientific research.[221] The ISA uses the Mining Code, a set of regulations, standards, and guidelines, to govern the three stages of seabed mining: prospecting, exploration, and exploitation. While the ISA has already established rules for the first two stages, it is currently working on regulations for the exploitation phase.[222]

Human rights are not explicitly addressed in UNCLOS Part XI on the Area or Part XII on the protection of the marine environment, as the links between the marine environment and human rights were not well understood at the time of UNCLOS's adoption.[223] The ISA, as the body responsible for regulating activities in the Area, now has an opportunity to incorporate human rights considerations into its regulatory framework. However, the current draft regulations under development by the ISA fall short in adequately addressing these concerns, leaving gaps in the protection of human rights in seabed mining activities.

Gaps in Existing ISA Regulations

The most recent publicly available version of the regulations includes some provisions relevant to the risks mentioned above. For instance, Regulation No. 2 outlines the "fundamental policies and principles" that govern seabed exploitation. Among other things, it emphasizes that

[219] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994).
[220] "Agreement on Part XI UNCLOS," accessed April 16, 2025, https://www.un.org/depts/los/convention_agreements/texts/agreement_part_xi/agreement_part_xi.htm.
[221] United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994), arts. 133(a), 136, 137, 140, 156(2), 153(1), 157(1), 143, 145, 160(2)(f)(ii), and 163(2)(b).
[222] "The Mining Code: Draft Exploitation Regulations - International Seabed Authority," March 17, 2022, https://www.isa.org.jm/the-mining-code/draft-exploitation-regulations-2/.
[223] Elisa Morgera and Hannah Lily, "Public Participation at the International Seabed Authority: An International Human Rights Law Analysis," *Review of European, Comparative & International Environmental Law* 31, no. 3 (2022): 374–88, https://doi.org/10.1111/reel.12472.

exploitation should be conducted in a manner that protects the marine environment from harmful effects and ensures that activities are carried out "for the benefit of mankind as a whole." This provision also lists key guiding principles, such as intergenerational equity, accountability, transparency in decision-making, and the application of the precautionary approach.[224] However, the regulations do not explicitly mention human rights, and the broad general principles that are relevant to human rights do not translate into adequate mechanisms within the rest of the regulatory framework.

More specifically, the current draft regulations require prospective contractors to submit Environmental Impact Assessments (EIAs) as part of their application for an exploitation contract in the form of an Environmental Impact Statement (EIS). While the template EIS annexed to the draft regulations considers "impacts on the socioeconomic environment," such as fisheries, marine traffic, and tourism, it does not expressly address human health, food security, or other direct human rights concerns. Without specific mention of these issues, there are no legal grounds to ensure that an EIA or EIS adequately considers the potential human rights impacts of the proposed activities.[225]

Additionally, the draft regulations do not include adequate mechanisms for participatory rights. Meaningful consultation and participatory rights are essential to ensuring that human rights are adequately considered within any governance framework. Here, while the draft regulations include some mechanisms to promote participatory rights, several commentators have pointed out significant shortcomings in that regard. For example, there is little focus on transparency, public participation, and access to justice for third parties. Importantly, the exploration regulations lack a process for third parties to object or provide input on exploration contracts. Although the draft exploitation regulations allow public comment on certain aspects of exploitation applications, the Legal and Technical Commission (LTC) is only required to consider these inputs, with no assurance that they will influence the decision. Furthermore, the decision-making process within the LTC is characterized by a lack of transparency, and there is no mechanism for third parties to contest the issuance of exploitation contracts.[226]

[224] "Draft regulations on exploitation of Mineral resources in the Area," ISBA/29/C/CRP.1, February 16, 2024, accessed April 15, 2025, Regulation No. 2, https://www.isa.org.jm/wp-content/uploads/2024/02/Consolidated_text.pdf.
[225] Graham J. Hamley, "The Implications of Seabed Mining in the Area for the Human Right to Health," *Review of European, Comparative & International Environmental Law* 31, no. 3 (2022), https://doi.org/10.1111/reel.12471.
[226] Graham J. Hamley, "The Implications of Seabed Mining in the Area for the Human Right to Health," *Review of European, Comparative & International Environmental Law* 31, no. 3 (2022): 397, https://doi.org/10.1111/reel.12471; Jeff A. Ardron, Henry A. Ruhl, and Daniel O. B. Jones, "Incorporating Transparency into the Governance of Deep-Seabed Mining in the Area beyond National Jurisdiction," *Marine Policy* 89 (February 1, 2018): 58–66, https://doi.org/10.1016/j.marpol.2017.11.021.

Other critics have pointed out the limited public participation in ISA decision-making, particularly the insufficient representation of civil society groups.[227] In fact, participatory opportunities at the ISA are currently inconsistent, often arising on an "ad hoc" basis, which can create barriers to access for some stakeholders. ISA outreach typically focuses on member States and observers already engaged with the organization, leaving out other relevant communities and interests. Furthermore, access to justice is hindered by the lack of options for administrative or judicial review, as well as the absence of a complaints mechanism, whistle-blowing procedures, or an ombudsperson. Despite member states recognizing public outreach and stakeholder engagement as a strategic priority in 2019, the ISA still lacks a clear policy or strategy to address these issues.[228]

Addressing Regulatory Gaps to Account for Human Rights Risks

In light of these deficiencies, significant improvements would be necessary for the regulations to adequately address human rights concerns:

In general terms, the framework should go beyond vague commitments and establish **concrete mechanisms to ensure meaningful public participation**.

This includes ensuring that all relevant stakeholders, including civil society groups, affected communities, and marginalized populations, have the opportunity to participate in decision-making processes. Participation should also not be ad hoc but rather institutionalized through clear procedures that guarantee early and adequate opportunities for public input. In addition, the ISA should be required to take public views into account, justify its decisions, and explain how stakeholder contributions were considered.

Finally, to achieve appropriate standards of public participation from an international human rights perspective, access to information must be affordable, effective, and timely to ensure that the public understands how environmental harm may impact rights such as life and health.[229]

An open letter co-signed by the UN Special Rapporteurs on Toxics and on Human Rights and the Environment also noted that the draft regulations must undergo significant revisions to align with international human rights standards and the UN Guiding Principles on Business and Human Rights (UNGPs). The letter argues that the regulations fail to acknowledge human rights

[227] Elisa Morgera and Hannah Lily, "Public Participation at the International Seabed Authority: An International Human Rights Law Analysis," *Review of European, Comparative & International Environmental Law* 31, no. 3 (2022): 374–88, https://doi.org/10.1111/reel.12472.
[228] Chris Pickens and et al., "From What-If to What-Now: Status of the Deep-Sea Mining Regulations and Underlying Drivers for Outstanding Issues," *Marine Policy* 169 (2024), https://doi.org/10.1016/j.marpol.2023.105967.
[229] Elisa Morgera and Hannah Lily, "Public Participation at the International Seabed Authority: An International Human Rights Law Analysis," *Review of European, Comparative & International Environmental Law* 31, no. 3 (2022): 374–88, https://doi.org/10.1111/reel.12472.

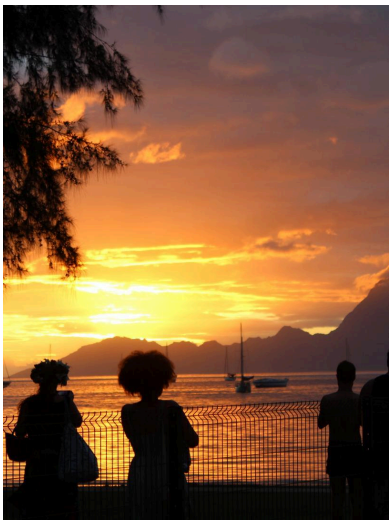
obligations, the responsibility of businesses to respect human rights, or the duty of ISA Member States to regulate and monitor corporate activities effectively.[230]

To address these gaps, the regulations should explicitly require businesses engaged in seabed mining to conduct human rights due diligence, including identifying, assessing, preventing, and mitigating human rights risks, as well as tracking and publicly reporting on their efforts. Additionally, affected individuals must have access to effective remedies in cases of harm, with clear mechanisms for accountability, particularly given the jurisdictional complexities of activities occurring beyond national borders. Without these changes, the draft regulations would likely fall short of international human rights standards.

In conclusion, despite uncertainty regarding the precise environmental and biodiversity impacts of deep-sea mining, existing evidence suggests potentially significant harm, with implications for, among others, the rights to food and to health. These potential harms require the integration of human rights considerations into the regulatory framework and the application of the precautionary principle. The current draft regulations currently fail to adequately address human rights risks. To align with international human rights frameworks, they should incorporate explicit human rights language, mandate human rights due diligence for businesses, and establish stronger public participation mechanisms.

2.5 Local Community and Indigenous Environmental Knowledge

Indigenous knowledge, including the ancestral, spiritual and cultural understanding of the environment, is critical to any discussion about the impact of deep-sea mining. Humans historically, as documented through oral tradition and terminology, have a responsibility to protect and restrict certain actions with the goal of caring for the land, sky, and ocean.



Local community and indigenous ways of knowing across the world, particularly in *tumu rai fenua*, are essential to any analysis of environmental impacts. This section looks at the connection between Indigenous knowledge and the environment; outlining why Indigenous voices and local communities are integral to any discussion that impacts the environment. To many Polynesians the land, the ocean and the sky are connected in a sacred relationship with humans. There is a deep connection

[230] "Open Letter by the Working Group on the Issue of Human Rights and Transnational Corporations and Other Business Enterprises, the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes and the Special Rapporteur on the Issue of Human Rights Obligations Relating to the Enjoyment of a Safe, Clean, Healthy and Sustainable Environment," (2024) accessed April 15, 2025, https://www.isa.org.jm/wp-content/uploads/2024/05/Letter-SPB-ISA.pdf.

between the people of Polynesia and nature, particularly the ocean.

Maire Bobb-Dupont, a French Polynesian activist and Tahitian teacher, explained that the ocean is the "pantry of humanity"; anything that harms or removes the ocean would therefore be akin to removing a person's womb.[232] Ms. Bobb-Dupont also noted that "the Ocean is us, it has spirit and is sacred". Across Polynesia, humans are understood as the "Guardians" of nature. This is evident through traditional Polynesian terminology,[233] including:

"**The Ocean is us, it has spirit and is sacred**"[231] - Maire Bobb-Dupont

Rahui: Form of restricting access to resources and/or territories. Seems to be a form of tapu applied to a class of resources or territory. Not just prohibition, as it is a form of *tapu,* so it is a sacred prohibition.

Raafui: To prohibit.

Mana: Power from divine influence or sacred power.

These terms signify the historic use of prohibition as a method for humans to live in harmony with the land, sky, and sea. The connection to divinity and sacredness is critical to understanding the nuance of these terms and when they were utilized historically.[234] Different socio-political groups in Polynesia had multiple ways of organizing, particularly about *rahui*, and multiple ways to implement sanctions if *rahui* regulations were infringed. Historically, the chiefs and sacred priests were empowered to prohibit dangerous actions based on the ancestral network's *mana* (sacred power). This historic Polynesian approach recognizes a distinction between the right of exploitation and the right of ownership. The ancestral concept of collectivity is less present in French Polynesia, particularly because of the French Civil Code.[235] Yet, the concept of collective ownership remains operational in some of the islands, for example the remote French Polynesian island of Rapa iti, where "collective goods, such as the land and the sea, can be used — and in a way appropriated — temporarily."[236]

[231] Maire Bobb-Dupont and Ismael, meeting with the Capstone team, March 17, 2025.
[232] Maire Bobb-Dupont and Ismael, meeting with the Capstone team, March 17, 2025.
[233] Tamatoa Bambridge, ed., *The Rahui: Legal Pluralism in Polynesian Traditional Management of Resources and Territories* (ANU Press, 2016), https://library.oapen.org/bitstream/handle/20.500.12657/32723/607554.pdf;jsessionid=D350735E2E9EAAEEE1EA73C51CF5368A?sequence=1.
[234] Tamatoa Bambridge, ed., *The Rahui: Legal Pluralism in Polynesian Traditional Management of Resources and Territories* (ANU Press, 2016), https://library.oapen.org/bitstream/handle/20.500.12657/32723/607554.pdf;jsessionid=D350735E2E9EAAEEE1EA73C51CF5368A?sequence=1.
[235] Tamatoa Bambridge, ed., *The Rahui: Legal Pluralism in Polynesian Traditional Management of Resources and Territories* (ANU Press, 2016): 47, https://library.oapen.org/bitstream/handle/20.500.12657/32723/607554.pdf;jsessionid=D350735E2E9EAAEEE1EA73C51CF5368A?sequence=1.
[236] Tamatoa Bambridge, ed., *The Rahui: Legal Pluralism in Polynesian Traditional Management of Resources and Territories* (ANU Press, 2016): 47, https://library.oapen.org/bitstream/handle/20.500.12657/32723/607554.pdf;jsessionid=D350735E2E9EAAEEE1EA73C51CF5368A?sequence=1.

"**It's important to talk about deep-sea mining on our own Indigenous terms, not just economic ones. The lowest depths of our moana, like the highest peaks of our *maunga*, are where our *atua* dwell. For that reason, they are tapu places**."
- Liam Kokaʻua[237]

These connections exist across the pacific; Liam Kokaʻua, a PhD student, Project Curator of Mātauranga Māori at Auckland Museum and an advocate against deep-sea mining, wrote an article in the magazine E-Tangata which discusses how the deep-sea is being colonized and ancestral knowledge of the sacred relationships are not being properly considered.[238] Liam explained that in Polynesian history, the Earth Mother can be understood not just as land-based, but as a spiritual force that goes down to the deep-sea as well.[239] Ancestral knowledge across Polynesia shows a spiritual connection between the role of humans in relation to the ocean and seabed.

Governance frameworks for deep-sea mining and its environmental impacts should therefore account for the interconnectedness of identity, spirituality, and the ocean. One innovative legal approach to centering non-human entities, such as the ocean, within legal systems is the concept of legal personhood, as outlined in the table below.

Brief Introduction to Legal Personhood and Environmental Rights

This section introduces the concept of legal personhood as a technique for reconciliation and environmental protection. Personhood is a technique to provide legal status to a human or non-human entity. Personhood is a theory of law that has been developed and refined over time. When an entity is understood as a "legal person", certain legal benefits, rights and protections are available.[240] The dominant western law narrative has granted corporations and humans legal personhood, but left behind animals, trees and other natural objects. Recent legal decisions and legal scholarship have pointed to the benefits, in pluralistic legal philosophy, of defending and recognizing an expansive concept of legal personhood towards other objects, such as rivers.[241] Scholars and practitioners have used this legal technique primarily as an Indigenous reconciliation tool, although it in turn can have practical uses for environmental aims.[242]

[237] Liam Kokaʻua, "Our Deep Sea Is Being Colonised", *E-Tangata*, April 2 2023, https://e-tangata.co.nz/comment-and-analysis/our-deep-sea-is-being-colonised/.
[238] Liam Kokaʻua, "'Our Deep Sea Is Being Colonised"', *E-Tangata*, 2 April 2 2023, https://e-tangata.co.nz/comment-and-analysis/our-deep-sea-is-being-colonised/.
[239] Liam Kokaʻua, Meeting with the Capstone Team on Zoom, April 9 2025.
[240] Samuel B Stratton, "Incorporating the Environment? Critiquing the Law's Structural Bias Against Nature and in Favor of Business Interests", *SJP* 1 (n.d.), https://systemicjustice.org/article/incorporating-the-environment-critiquing-the-laws-structural-bias-against-nature-and-in-favor-of-business-interests/.
[241] Asanka Edirisinghe and Sandie Suchet-Pearson, "Nature as a Sentient Being: Can Rivers Be Legal Persons?", *Review of European, Comparative & International Environmental Law* 33, no. 2 (2024), https://onlinelibrary.wiley.com/doi/full/10.1111/reel.12529.
[242] Monica Evans, "Is 'Legal Personhood' a Tool or a Distraction for Maori Relationships with Nature?," *Mongabay*, July 2024, https://news.mongabay.com/2024/07/as-maori-heal-through-nature-is-legal-personhood-a-tool-or-a-distraction//.

Across Polynesia, Gods and spiritual beings are often viewed as personifications of nature, and given names and attributions that align with nature. This deep sacred connection shows a value and importance of these beings and "inanimate objects" that is not represented in Western legal understanding. This may be a practical claim for nations to make about natural elements that hold environmental and Indigenous value.

Legal Personhood Claims

In 2019, New Zealand granted The Whanganui River legal personhood through *The Te Awa Tupua (Whanganui River Claims Settlement) Act* 2017, a result of a Treaty of Waitangi settlement.[243] Whanganui River was the first river to receive legal personhood. Through this legislation, an office was created to uphold the legal status of the river by speaking on behalf of it and promoting its health.[244] New Zealand has also granted legal personhood to a rainforest, whales and dolphins, and most recently a mountain.[245]

The mountain was granted legal personhood in January 2025. Section 18 of the *Te Pire Whakatupua mō Te Kāhui Tupua/Taranaki Maunga Collective Redress Bill* granting personhood explains the designation:

> Te Kāhui Tupua as legal person
>
> (1) Te Kāhui Tupua is a legal person and has all the rights, powers, duties, responsibilities, and liabilities of a legal person.
>
> (2) The rights, powers, and duties of Te Kāhui Tupua must be exercised and performed, and responsibility for its liabilities must be taken on behalf of, and in the name of, Te Kāhui Tupua [...].

Environmental Rights Claims

Other countries and companies have engaged with rights-based arguments and strategies. Ecuador was the first country to enshrine 'rights of nature' in its constitution in 2008.[246] The Scottish Association for Marine Science, a charitable research institute, recently made a similar decision to legal personhood by voting to make the ocean, represented by a specific

[243] 'Te Awa Tupua (Whanganui River Claims Settlement) Act', Pub. L. No. 2017 No 7 (2017), https://www.legislation.govt.nz/act/public/2017/0007/latest/whole.html.
[244] Hannah White, "Indigenous Peoples, the International Trend Toward Legal Personhood for Nature, and the United States", *American Indian Law Review* 43, no. 1 (2018): 151, https://digitalcommons.law.ou.edu/cgi/viewcontent.cgi?article=1695&context=ailr.
[245] Kristine Sabillo, "Taranaki Maunga, New Zealand Mountain, Declared a "Legal Person"", *Mongabay*, February 20, 2025, https://news.mongabay.com/short-article/taranaki-maunga-new-zealand-mountain-declared-a-legal-person/.
[246] Viktoria Kahui, "Granting Legal "Personhood" to Nature Is a Growing Movement – Can It Stem Biodiversity Loss?", *The Conversation*, 25 April 2024, https://theconversation.com/granting-legal-personhood-to-nature-is-a-growing-movement-can-it-stem-biodiversity-loss-227336.

person or a working group, a trustee on its board.[247] Although not completed yet, the Government of Cabo Verde has led the charge toward *a Universal Declaration of Ocean Rights (UDOR)* by 2030, which would recognize rights of the ocean.[248]

Recognizing and addressing the deep cultural and spiritual connection between the ocean, including the deep sea, and communities in places like French Polynesia is crucial in framing deep-sea mining discussions. This connection and any threats to related cultural heritage must be considered in any assessment of the industry's environmental impact.

2.6 The Myth of Deep-Sea Mining as "Clean Mining"

Deep-sea mining is often positioned as a sustainable or "clean" alternative to terrestrial mining, emphasizing its reduced footprint and potential to meet the growing global demand for critical minerals (see **Chapter 3**). A growing body of scientific evidence challenges the claim that deep-sea mining can be conducted without significant environmental harm.[249] As explained above, this environmental harm could give rise to adverse human rights implications if it threatens human health, food security, and the continued protection of cultural heritage.

The environmental impacts of deep-sea mining could be far-reaching. As foregrounded, the impacts are driven primarily by the individual and combination of effects from the direct physical removal of the seabed substrate, the generation of sediment plumes, and subsequent habitat destruction. Initial studies assessing long-term impacts of even small-scale experimental mining activities demonstrate these disturbances as persistent, altering biological communities, and ecosystem functioning for decades. For example, evidence from mining sites in the CCZ from 1979 mining tests show ecological disruption lasting at least 44 years after initial activity compared to control areas, including continued physical alteration of habitats and significant shifts in biological community compositions.[250]

Deep-sea mining is clearly a way to circumvent and substitute risks associated

[247] Anna Turns and Nicholas John Paul Owens, "Why Has This Marine Research Institute Made the Ocean a Member of Its Board? Expert Q&A," *The Conversation*, January 10, 2025, https://theconversation.com/why-has-this-marine-research-institute-made-the-ocean-a-member-of-its-board-expert-qanda-246668.

[248] "Towards a Universal Declaration of Ocean Rights (UDOR): Concept Note", 2023, https://static1.squarespace.com/static/55914fd1e4b01fb0b851a814/t/646523cd9c8b6d4f55abaa3c/1684349908559/UDOR_Concept+Note+%281%29.pdf

[249] Kathryn A. Miller et al., "An Overview of Seabed Mining Including the Current State of Development, Environmental Impacts, and Knowledge Gaps," *Frontiers in Marine Science* 4 (January 10, 2018), https://doi.org/10.3389/fmars.2017.00418.

[250] Daniel Jones et al., "Biological Responses to Disturbance from Simulated Deep-Sea Polymetallic Nodule Mining," PLOS ONE 12, no. 2 (February 8, 2017): e0171750, https://doi.org/10.1371/journal.pone.0171750.s.

with terrestrial mining. By nature, deep-sea mining will not cause environmental hazards such as deforestation and freshwater pollution common to terrestrial mining projects and that are known to impact communities neighboring mines on land. Further, accessing deep-sea mineral deposits for exploitation means mining operations would need to be large-scale, so that monitoring labor and regulatory compliance would theoretically be easier.[251] When compared with terrestrial mining, deep-sea mining could therefore avoid the potential for associated human rights abuses. However, distant-water fishing operations suggest this may not always be the case. Despite size and monitoring powers, labor outcomes in these operations are not always guaranteed. In fact, as outlined in **Chapter 1**, jurisdictional uncertainties in the high seas have hindered the effective enforcement of labor standards in other industries operating in remote maritime environments. Deep-sea mining activities introduce additional occupational health and safety risks arising from the physical and psychological demands of working in confined, isolated locations under extreme weather conditions. Recent findings on the potential radioactivity of polymetallic nodules heighten these concerns, as they may expose workers to serious long-term health hazards.

There are also difficulties associated with monitoring deep-sea mining activities, given how far they will be performed below sea-level. Countries mining within their EEZs are unlikely to have the resources and technical capacity to monitor compliance with permits and check for unexpected impacts given the cost of operation in the deep sea. The very nature of deep-sea mining therefore makes it much harder to identify and track damage compared to terrestrial mining. The subterranean location of mining creates greater risks that we may be unaware of damage at the time it occurs, making deep-sea mining riskier than terrestrial mining in many respects.

Recent technological advancements have improved ocean mapping capabilities. Mapping is essential for exploration and baselining. The improved understanding of deep-sea biodiversity, ecosystem dynamics, and connectivity have simultaneously highlighted the incomplete state of current scientific knowledge. Ecological baselines necessary for evidence-based environmental management are insufficient in all current exploration areas, including the CCZ.[252] While these gaps persist, the ability to anticipate, manage, and mitigate impacts from commercial-scale mining remains limited. Recent scientific discoveries add further complexity to the gaps in scientific literature. Studies, like the one on the discovery of Dark Oxygen, emphasize previously unknown ecological processes occurring in deep-sea environments targeted for mining. Such findings underline the risk of irreversibly disrupting critical yet poorly understood ecological processes through mining activities. The range of potential impacts was highlighted in an interview with a scientist who has researched the deep sea for 15 years:

> "[Deep-sea mining] would have very significant potential long-term ecological impacts. In terms of different types of organisms… starting off at the larger size classes of organisms;

[251] Vlado Vivoda, "Uncharted Depths: Navigating the Energy Security Potential of Deep-Sea Mining," *Journal of Environmental Management* 369 (October 1, 2024): 122343, https://doi.org/10.1016/j.jenvman.2024.122343.
[252] Diva J. Amon et al., "Assessment of Scientific Gaps Related to the Effective Environmental Management of Deep-Seabed Mining," *Marine Policy* 138 (April 1, 2022): 105006, https://doi.org/10.1016/j.marpol.2022.105006.

mega fauna, fish, corals, sponges and things. The nodules themselves are very important habitat in that area at very high water depths or large water depths. Removal of them is kind of akin to for example clear felling a forest and removing that habitat space for animals that would use that on land. So if you're removing those nodules, removing the habitat, that will have severe impact on the organisms that would be relying on that environment. Both through direct mortality for organisms that cannot move, like the corals and sponges. And then just, reduce survival prospects for the organisms that would be utilizing that area…

The other interesting part for me, I think, is thinking about microbes. And there is not a great understanding, really. But evidence suggests they are very important for carbon, as part of the carbon cycle and other nutrient cycles. And disturbing that sea floor area might distrust that significantly and could lead to knock-on effects in terms of greenhouse gas emissions, potentially from seafloor ecosystems."[253]

Finally, assessments from international environmental bodies have explicitly stated that under current scientific and technological conditions, deep-sea mining operations cannot credibly claim to be environmentally benign or sustainable.[254] The impacts extend beyond the mining sites themselves to potentially affect marine biodiversity, fisheries, carbon sequestration, and broader ocean health. The scale, irreversibility, and persistent nature of these impacts puts deep-sea mining in conflict with principles of environmental precaution and sustainability.

In conclusion, given current scientific knowledge and technological capabilities, deep-sea mining cannot be conducted in a genuinely "clean" or "harmless" manner. The environmental risks, characterized by high uncertainty, prolonged ecological disruption, and irreversible habitat loss, substantially outweigh potential economic benefits under current conditions. A truly sustainable and precautionary approach would require significant advances in ecological understanding, robust baseline data, and proven mitigation technologies. None of these currently exist at the necessary scale or effectiveness to comfortably allow for exploitation.

Conclusion

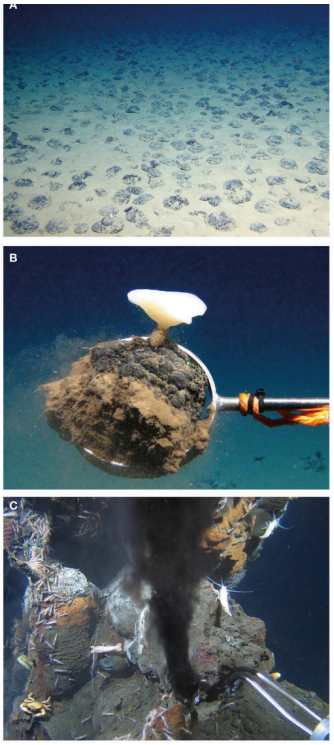
The concept of deep-sea mining as "clean" is scientifically unfounded. Current evidence clearly demonstrates extensive and long-lasting environmental damage from deep-sea mining activities. The discovery of dark oxygen underscores the fundamental scientific uncertainties and complexities of deep-sea ecosystems, highlighting substantial ecosystem risks from industrial

[253] Dr Oliver Ashwell, Interview, 10 March 2025
[254] United Nations Environment Program, "Harmful Marine Extractives: Deep-Sea Mining," Briefing Paper, June 2022, https://www.unepfi.org/publications/harmful-marine-extractives-deep-sea-mining/.

activities. For French Polynesian and global stakeholders, prioritizing robust scientific research, indigenous knowledge, transparent governance, and effective international coordination is critical before any consideration of moving deep-sea mining from exploration to exploitation is pursued. The environmental, cultural, human rights, and governance risks presented in this chapter clearly outweigh potential short-term economic benefits, necessitating a cautious, science-driven approach to decision-making.

Chapter 3. Energy Transition: The Use of Critical Minerals in the Energy Transition – A Need For Deep Sea Minerals?

Many emerging energy and defence technologies depend on "critical minerals" such as lithium, cobalt, nickel, copper and rare earth elements. The current geographical distribution of these materials raises issues of energy security, supply chain vulnerabilities, and geopolitical risk.[255] The growing demand for critical minerals, often framed as essential for economic and national security,[256] is being used to justify the accelerated speed to exploit underwater resources through deep-sea mining.



Proponents of deep-sea mining portray it as a cleaner alternative to access critical minerals than terrestrial mining, but mounting scientific evidence, examined in **Chapter 2**, undermine this claim. Many of the critical minerals found in polymetallic nodules (copper, cobalt, nickel and manganese) experienced vertiginous price increases around 2022, following dramatic forecasted demand increases. This drove the most recent wave of interest in deep-sea mining. However, since 2022, short-term demand forecasts have moderated significantly; this is also reflected in the price structure of copper, cobalt, and nickel. This chapter summarizes the current status of critical mineral demand, supply, as well as technological developments that will influence demand across different time horizons.

The global energy transition is expected to significantly increase demand for critical minerals. The transition will therefore be both mineral- and metal-intensive. While most current demand for these materials is unrelated to clean energy, projections uniformly demonstrate rapid growth as the transition accelerates. For example, IRENA's 1.5°C scenario demonstrates the scale of infrastructure required: 33,000 GW of renewable power and the electrification of

[255] Sophia Kalantzakos, "The Race for Critical Minerals in an Era of Geopolitical Realignments," *The International Spectator* 55, no. 3 (July 2, 2020): 1–16, https://doi.org/10.1080/03932729.2020.1786926.
[256] Sarah M. Hayes and Erin A. McCullough, "Critical Minerals: A Review of Elemental Trends in Comprehensive Criticality Studies," *Resources Policy*, Sustainable management and exploitation of extractive waste: towards a more efficient resource preservation and waste recycling, 59 (December 1, 2018): 192–99, https://doi.org/10.1016/j.resourpol.2018.06.015.

90 percent of road transport by 2050. This translates into demand for vast quantities of critical materials in the coming decades.[257]

Despite its frequent use in discussions of the transition, there is no universally accepted definition of what constitutes a "critical" material. National and regional lists reflect varying economic, geopolitical, and technological contexts for inclusion. For example, IRENA's review identifies 51 materials that are critical to the renewables-based transition across 35 different lists.[258] Further, the amount of critical minerals needed for the energy transition is highly uncertain. Forecasts of growth in cobalt demand in 2040, for example, vary by a factor of more than 12; forecasts of demand for other key minerals often vary by a factor of four or more.[259]

Critical minerals pose different challenges to energy security compared to fossil fuels. Unlike fossil fuels, supply disruptions in critical materials pose limited threats to operational energy security but can significantly delay the pace of energy transitions. Given the need to accelerate the transition, such delays can have major consequences. Dependency on these materials also differs from fossil fuels: China controls a significant amount of the access to critical minerals and the supply chains for many renewable energy technologies: for example, over 80 percent of rare earth elements are sourced from China, leading to supply vulnerabilities and market volatility.[260]

Alternate risk management strategies are being proposed where deep-sea mining is a way of rebalancing supply. While physical scarcity of critical minerals is not a concern, short- to medium-term bottlenecks may arise due to limited mining and refining capacity, as well as underinvestment in upstream supply. Expanding recycling technology, growing reserves, and ongoing product innovations in material efficiency and substitution suggest that such constraints will be manageable.

Emerging battery chemistries such as lithium-iron phosphate, sodium-ion, and solid-state technologies are rapidly reducing dependence on minerals like cobalt and nickel, many of which are the primary targets of deep-sea mining. These technological innovations promise to lower costs and increase the adoption of clean energy technologies while also dramatically altering the demand landscape for various critical minerals. This results in significant price volatility and uncertainty in forecasting.

In parallel, circular economy strategies, including recycling, material substitution, and product lifetime extension, discussed in greater detail later in this Chapter, are developing rapidly and could substantially narrow or even eliminate future supply gaps in the medium term.[261] The

[257] International Renewable Energy Agency, "Geopolitics of the Energy Transition: Critical Materials," April 18, 2024, https://www.irena.org/Digital-Report/Geopolitics-of-the-Energy-Transition-Critical-Materials.
[258] International Renewable Energy Agency, "Geopolitics of the Energy Transition: Critical Materials," April 18, 2024, https://www.irena.org/Digital-Report/Geopolitics-of-the-Energy-Transition-Critical-Materials.
[259] *The Global E-waste Monitor 2024: Understanding the Challenges of the Global E-waste Landscape and Making E-waste Visible*. Geneva: International Telecommunication Union, United Nations Institute for Training and Research, United Nations University, and International Solid Waste Association, 2024. Accessed April 20, 2025. https://www.itu.int/en/ITU-D/Environment/Pages/Publications/The-Global-E-waste-Monitor-2024.aspx.
[260] Vlado Vivoda, "Uncharted Depths: Navigating the Energy Security Potential of Deep-Sea Mining," *Journal of Environmental Management* 369 (October 1, 2024): 122343, https://doi.org/10.1016/j.jenvman.2024.122343.
[261] André Månberger, "Critical raw material supply matters and the potential of the circular economy to contribute to security." *Intereconomics* 58, no. 2 (2023): 74-78.

considerable ecological risks of deep-sea mining, volatility in short-term demand forecasts, and rapid pace of innovation in these technologies, combined with potential for alternatives, make deep-sea mining less of an immediate necessity.

3.1 What Critical Minerals are needed in the Energy Transition?

The global shift towards renewable energy systems includes demand for wind turbines, solar photovoltaics (PV), electric vehicles (EVs), and battery storage. These technologies rely significantly on various combinations of critical minerals, which primarily include lithium, cobalt, nickel, copper, manganese, and rare earth elements such as neodymium and dysprosium. Lithium, cobalt, and nickel are essential components in most lithium-ion batteries, which are currently dominant in EVs and stationary energy storage solutions (for example, in grid-utility batteries). Copper is crucial for building electricity networks, EVs, wind turbines, and solar panels due to its electrical conductivity.

Manganese plays a vital role in battery chemistries, specifically lithium manganese oxide (LMO) and lithium nickel manganese cobalt oxide (NMC). Neodymium and dysprosium help create the powerful magnets used in wind turbine generators and EV motors.

The demand for these minerals is predicted to increase significantly as clean energy technologies proliferate. However, forecasts vary due to uncertainties regarding technology evolution, potential shifts in consumer behavior, and policy impacts on resource efficiency and recycling.

What critical minerals are in the deep seabed?

The CCZ contains large deposits of polymetallic nodules. The nodules are primarily composed of manganese and also contain nickel, copper, and cobalt. Estimates vary given the difficulty of mapping the resources available, but Vivoda estimates the CCZ to contain up to 274 million metric tons of nickel, 226 million metric tons of copper, and approximately 44 million metric tons of cobalt.[262] Lithium and rare earth elements, however, are present only in trace amounts and are not economically viable for extraction from these nodules.

According to a report by the International Energy Agency (EIA), an electric car requires six times the mineral resources of a traditional vehicle, an onshore wind project requires nine times the resources needed for a gas-fired plant, and an offshore wind project requires 13 times more mineral resources than a similarly sized gas-fired plant.[263] Critical minerals are also used throughout the clean energy supply chain. For example:

[262] Vlado Vivoda, "Uncharted Depths: Navigating the Energy Security Potential of Deep-Sea Mining," *Journal of Environmental Management* 369 (October 1, 2024): 122343, https://doi.org/10.1016/j.jenvman.2024.122343.
[263] International Energy Agency (IEA), *The Role of Critical Minerals in Clean Energy Transitions* (Paris: IEA, 2021), accessed April 20, 2025, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions.

Copper wiring is used to build transmission lines and other infrastructure to connect projects to the electricity grid. The amount of copper needed for offshore wind projects is even greater given their distance from onshore load centers.

Nickel is used in wind turbines, battery energy storage systems (BESS), and EV batteries.

Copper, **silicon**, **silver**, and **zinc** are used in the manufacture of solar panels.

Lithium, **cobalt**, **manganese**, and **graphite** are used in BESS and EV batteries.

Rare Earth Elements are important in the manufacture of magnets used in wind turbines and EVs.

Forecasts assessing the extent of critical mineral demand in this sector vary radically. A World Bank study concluded that batteries are the fastest changing technology sector, making it virtually impossible to forecast which technology will be the most used from now until 2050.[264] For example, a 2023 meta-analysis by the International Energy Forum found huge variance across forecasts:[265]

Cobalt: Demand for energy transition technologies in 2040 varied from 58 percent to 725 percent of 2022 global demand. The highest and lowest estimates differed by a factor of 12.5 times.

Copper: Demand forecasts for 2040 varied from approximately 25 percent to 100 percent of 2022 demand, a factor of approximately four.

Nickel: Demand forecasts varied from 33 percent of 2022 demand to 154 percent, nearly a factor of five.

Lithium: Demand forecasts for clean energy varied from 254 percent of 2022 demand to more than 1,000 percent, a factor of about four.

Uncertainty around the future energy mix and the specific material needs of various technologies drive this variation. Regardless, many analysts predict terrestrial mineral reserves to be sufficient to meet the clean energy demand and the Paris Agreement emissions reduction targets.[266] This is predominantly due to technological developments from product developers and operational efficiency gains of the mining sector. However, terrestrial mining does present several issues

[264] "Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition", World Bank Publications, 2020, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099052423172525564/p16627806f5aa400508f8c0bdcba0878a3e.
[265] Juliet Akamboe et al., International Energy Forum and Payne Institute of Public Policy, *Critical Minerals Outlooks Comparison*, August 2023, https://www.ief.org/focus/ief-reports/critical-minerals-outlooks-comparison
[266] International Energy Agency, "Executive Summary – The Role of Critical Minerals in Clean Energy Transitions – World Energy Outlook," IEA, May 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary.

causing governments and investors to consider deep-sea mineral resources as an alternative supply source. These issues include:

- The time required to develop new mines. It can take up to 15 years to develop a mine depending on the mineral, the project, and the legal and regulatory regime to which the project is subject.
- The concentration of important minerals in specific geographical locations. For example, as of 2023:
    - Australia, Chile, and China dominate lithium production. They produce 46.9%, 30%, and 14.6%, of the world's lithium respectively;
    - Chile, Peru, and the Democratic Republic of Congo (DRC) dominate copper production. They produce 23.6%, 10%, and 10%, of the world's copper respectively;
    - The DRC, Indonesia, and Russia dominate cobalt production. They produce 70%, 5.4%, and 4.8% of the world's cobalt respectively, although mines in the DRC are primarily owned or financed by Chinese investors;;
    - South Africa, Gabon, and Australia dominate manganese production. They produce 35.8%, 22.9%, and 16.4% of the world's manganese respectively; and
    - Indonesia, the Philippines, and Russia dominate nickel production. They produce 48.8%, 10.1%, and 6.7% of the world's nickel respectively.

Deep sea mining is presented as a solution to both the timing and geographic concentration issues of terrestrial mining. Proponents argue that extracting minerals from the ocean floor will ease supply constraints, diversify sourcing away from geopolitically concentrated terrestrial reserves, and accelerate the deployment of clean energy technologies. However, as noted in **Chapter 2**, a growing body of scientific and policy research challenges this narrative.

3.2 Recent Trends in Critical Mineral Forecasting: Demand Volatility, Supply Stabilization

Copper, nickel and cobalt are the most valuable and important metals found in polymetallic nodules across the CCZ. The 2022 price boom for these minerals was driven by unrealistic demand scenarios, predominantly linked to energy transition scenarios, which, in turn, raised supply concerns for these metals. Since 2022, prices have leveled off considerably (see Figure 1 at the end of this section). The supply forecast has also become more certain, especially in the short term.

Volatility is important for two reasons. First, the viability of deep-sea mining projects is predicated on cost structures of these minerals. The risk of volatility will increase these projects' already substantial upfront costs. Second, the reduction in demand-driven price increases from 2020-2022 creates a scenario where the supply of at least nickel and cobalt will be secured in the short term (to 2030). This weakens the argument for rushing into commercial deep-sea mining.

Substantial volatility in supply and demand for these critical minerals undermines the economic viability of deep-sea mining operations. Deep-sea mining requires very high upfront capital investment. Projects have long timelines and high fixed costs if exploratory assessments and environmental compliance are adequately performed. Highly specialized technological infrastructure is also required. These substantial initial expenditures make their financial returns, and the royalties to host or sponsoring states, highly dependent on stable and predictable mineral prices. Recent price fluctuations, however, demonstrate the lack of predictability in these markets. Knowing where deep-sea mining projects are located on the cost curve is essential to predict their viability and the royalties they could generate.

Further, the short and medium demand scenarios for key deep-sea nodule minerals have significantly decreased since the demand-driven price spikes of 2022. Cobalt and nickel prices surged and subsequently plummeted for a variety of reasons, including policy decisions, forecasting misjudgements and rapid technological shifts. Changing consumer behaviors, and geopolitical influences also played a role.[267] For example, cobalt prices rose dramatically from 2020 through 2022, driven by soaring forecast demand for electric vehicle batteries, only to collapse sharply by 2024 as battery manufacturers shifted to low-cobalt or cobalt-free chemistries such as lithium-iron phosphate (LFP, examined in a case study later in this chapter). Similarly, nickel faced sharp price volatility driven by fluctuating EV demand, oversupply from Indonesia, and evolving battery technologies.

The following sections give a brief overview of demand-supply balance for key minerals, with Figure 1 showing the price volatility of each. The key takeaway is that expected supply from already announced projects is within range of projected 2035 requirements to reach national and global climate goals, with the exception of copper.

Copper

Copper plays an essential role in electrical wiring for EVs, renewable energy systems, and grid infrastructure. Its demand has been the most stable, increasing by 40 percent from 2017 to 2022.[268] Today's copper supply is relatively diversified compared with the other key energy transition minerals, although new pressures are emerging. The rise of artificial intelligence (AI) and data centers has intensified copper demand, with prices climbing about 20 percent since

[267] "Global Critical Minerals Outlook 2024", IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024.
[268] "Global Critical Minerals Outlook 2024", IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024.

early 2024. In its 2024 Critical Minerals Outlook, the IEA warned of potential supply deficits by the end of 2025, as the demand from AI-related infrastructure and renewable energy projects may outpace supply.

While copper production is projected to increase, it is unlikely to meet the growing demand. Existing mines and projects under construction are expected to only meet 80 percent of copper needs by 2030. Several strategies are being considered to address the impending copper shortage, including investing in terrestrial copper sources, promoting recycling, developing more efficient technologies, and diversifying supply chains.[269] The amount of copper on the deep seabed is unlikely to significantly influence the supply-demand gaps and is a fraction of what is available from land-based resources.[270]

Cobalt

Cobalt prices have experienced sharp peaks and troughs over the past decade. After peaking above USD 90,000 per tonne in 2018 due to surging demand for EV batteries, prices fell to around USD 30,000 by 2019 due to oversupply and the increasing adoption of lower-cobalt chemistries. Prices rebounded in 2021-2022, reaching approximately USD 70,000 per tonne, driven by strong post-pandemic EV growth, strong policy commitments, and renewed investor interest. However, by 2024, cobalt prices had dropped to below USD 25,000 per tonne, as market dynamics shifted once again.

Cobalt demand surged between 2017 and 2022, increasing by approximately 70 percent. However, in 2023, the supply of cobalt exceeded demand by 6.5 percent, leading to a significant drop in prices. This oversupply was attributed to increased production and a shift in battery chemistry preferences, with manufacturers moving towards lower-cobalt or cobalt-free alternatives like lithium iron phosphate (LFP) batteries.[271]

The volatility reflects both increased supply, particularly from the Democratic Republic of Congo, and demand-side adjustments. Major EV producers have moved away from cobalt-intensive battery chemistries, opting instead for alternatives such as LFP, which offer lower costs and fewer supply chain concerns. Further, ethical and geopolitical issues related to cobalt sourcing have accelerated the search for substitutes.

Nickel

Nickel prices have followed a similarly volatile trajectory. Between 2019 and 2022, prices rose from approximately USD 13,000 to over USD 25,000 per tonne, bolstered by optimism about its

[269] Éléonore Lèbre et al., "Mining on Land or in the Deep Sea? Overlooked Considerations of a Reshuffling in the Supply Source Mix," *Resources, Conservation and Recycling* 191 (April 1, 2023): 106898, https://doi.org/10.1016/j.resconrec.2023.106898.
[270] Éléonore Lèbre et al., "Mining on Land or in the Deep Sea? Overlooked Considerations of a Reshuffling in the Supply Source Mix," *Resources, Conservation and Recycling* 191 (April 1, 2023): 106898, https://doi.org/10.1016/j.resconrec.2023.106898.
[271] International Energy Agency, "Mineral Requirements for Clean Energy Transitions – The Role of Critical Minerals in Clean Energy Transitions – Analysis," IEA, accessed April 22, 2025, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/mineral-requirements-for-clean-energy-transitions.

central role in high-energy-density battery chemistries and fears of supply disruptions linked to the Russia-Ukraine conflict. In March 2022, a short squeeze involving Chinese producer Tsingshan caused nickel prices to spike temporarily above USD 100,000 per tonne, forcing the London Metal Exchange to suspend trading.[272]

Since then, prices have corrected sharply. By 2024, nickel prices had declined to around USD 16,000–18,000 per tonne, reflecting oversupply coming mainly from Indonesia, which has rapidly scaled up low-cost nickel production through integrated industrial parks and state-backed projects. Battery-grade nickel remains in demand. However, a mismatch has emerged between refined nickel supply and the specifications required by battery manufacturers. This oversupply risk is compounded by slower-than-expected EV sales growth in 2023 and continued shifts toward nickel-free chemistries. Further, from 2017 to 2022, demand rose by 40 percent, driven by its application in high-energy-density batteries. In 2023, nickel supply outpaced demand by 8 percent, resulting in a 50 percent decline in prices. This surplus was due to increased production, mainly from Indonesia, and a deceleration in EV sales, especially compared to bullish forecasts.

Manganese

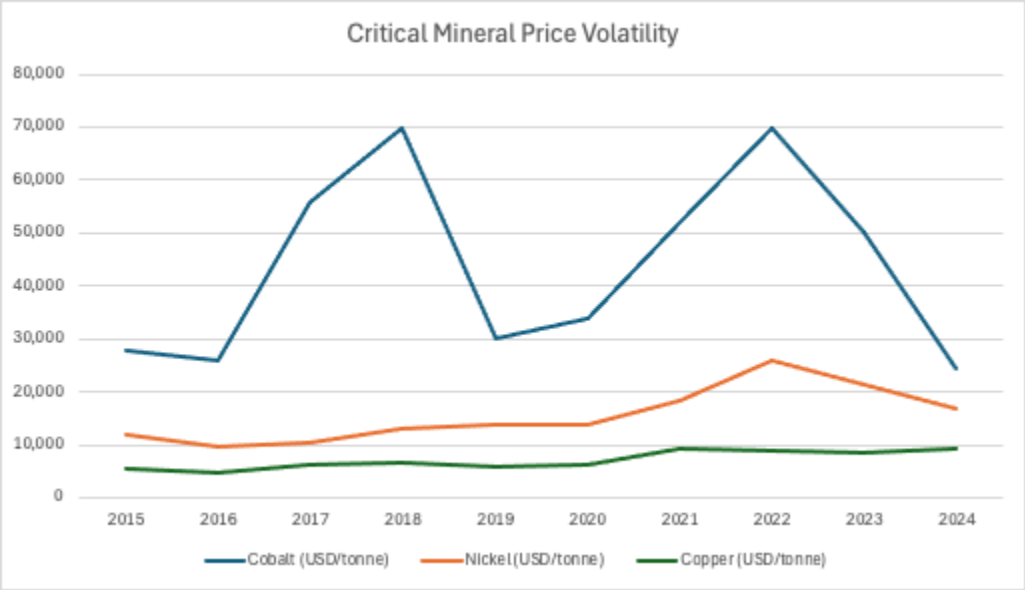
Manganese is the most abundant mineral found in polymetallic nodules. It is less central to the energy transition compared to minerals like cobalt, nickel, or lithium. One key reason is its lower market value. High-purity manganese sulfate is used in battery production and trades at around $1,000–$2,000 per tonne, significantly less than cobalt, nickel, or copper. This diminishes its attractiveness as a driver for deep-sea mining investments.

In lithium-ion battery chemistries such as NMC (nickel-manganese-cobalt), manganese plays a stabilizing role, but is not the performance-limiting element; those are typically cobalt or nickel.[273] Moreover, several fast-growing battery technologies like LFP and sodium-ion batteries do not use manganese at all, reducing its strategic importance.

Unlike cobalt, manganese is also geologically abundant and widely distributed, with top producers like South Africa, Australia, and Gabon offering well-established, secure supply chains. This widespread availability means that geopolitical or supply chain risks are relatively low. Further, approximately 90 percent of global manganese demand is still tied to steel production, not clean energy applications.[274] The combination of lower price, abundant supply, its secondary role in battery chemistry, and dominant use in conventional industries means manganese does not carry the same strategic importance in clean energy supply chains. As a result, securing manganese supply does not provide a strong justification for the environmental and regulatory risks associated with deep-sea mining.

[272] International Energy Agency, "Executive Summary – The Role of Critical Minerals in Clean Energy Transitions – World Energy Outlook," IEA, May 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary.
[273] Hannah Ritchie, "We Have Enough Minerals for the Energy Transition, but Medium-Term Supply Is a Challenge [Part 1]," November 18, 2024, https://www.sustainabilitybynumbers.com/p/transition-mineral-demand-part-one.
[274] International Energy Agency, "Executive Summary – The Role of Critical Minerals in Clean Energy Transitions – World Energy Outlook," IEA, May 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary.

Figure 1: Critical Mineral Volatility[275]



3.3 Critical Mineral Volatility and Deep-sea Mining: Demand Will Not Meet Supply in Short or Medium Term

Such rapid market swings expose deep-sea mining ventures, which could take over a decade to begin commercial extraction, to considerable financial risk. Unlike terrestrial mines that can scale operations or temporarily suspend production to adapt to price changes, deep-sea mining operations are less flexible due to their high fixed costs and logistical complexities. Moreover, investors and lenders, wary of volatile markets, may become increasingly reluctant to finance high-risk ventures like deep-sea mining, particularly when terrestrial sources or recycling offer more predictable, lower-risk alternatives. Consequently, price volatility not only undermines current economic forecasts for deep-sea mining but also casts doubt on its long-term commercial feasibility. This uncertainty reinforces this report's case for applying the precautionary principle.

Although demand for critical minerals is anticipated to increase, several factors are mitigating the need for deep-sea mining in the short to medium term. Terrestrial mineral reserves combined with advances in recycling technologies show that primary land-based extraction can adequately meet demand. This view is shared on the industry side of demand. According to a survey conducted by KPMG, almost 80 percent of executives in the metals and mining industry are

[275] Ev Metals | London Metal Exchange, accessed May 20, 2025, https://www.lme.com/en/metals/ev.

confident or very confident that the industry will be able to meet the rising demand.[276] The view of executives is reflected in the growing number of businesses, including major EV brands and battery companies such as BMW, Rivian, Renault, Scania, Volvo, and Volkswagen, which support a moratorium on deep-sea mining.[277]

The wide range of forecasts discussed in Section 3.2 show the unpredictability of long-term demand dynamics. The steepest growth in demand for minerals will clearly take place in the present decade, according to the IEA's predictions. After 2030, growth in demand for key minerals will continue at a lower rate in both ambitious and less ambitious energy transition scenarios. Deep-sea mining companies are unlikely to be operational until after the demand for critical minerals has peaked, making the industry unlikely to play an important role in mitigating near-term shortages of critical minerals. Deep-sea mining will only influence short term markets for nickel and cobalt, both of which are highly likely to have sufficient supply to meet short term demand. Further, long-term demand for these metals is especially uncertain given the rapid evolution of battery technology.[278]

In conclusion, deep-sea mining would not meaningfully alleviate the short-term supply constraints of the global critical minerals markets of copper, nickel, and cobalt. These are more effectively addressed through terrestrial extraction improvements, recycling, and technological supply chain innovation.

3.4 Future Trends in Critical Mineral Usage: Technology Improvements, Recycling, and the Circular Economy

Technologies across the critical minerals supply chain are evolving rapidly. Recycling processes for end-of-life batteries, wind turbine magnets, and solar panels are being developed to recover valuable materials such as cobalt, nickel and rare earth elements.[279] Recycling aims to reduce the new supply required, while lowering the mining's environmental footprint and processing and creating a more sustainable supply chain. Governments are trying to incentivize these practices. For example, the EU launched the European Battery Alliance in 2020, focused on securing a domestic and sustainable supply of battery materials through recycling and innovation.[280] Similar strategies are being implemented globally, reflecting a growing recognition of the need to

[276] Trevor Hart and Ugo Platania, "KPMG 2024 Global Metals and Mining Outlook," KPMG, 2024, https://kpmg.com/xx/en/our-insights/risk-and-regulation/kpmg-2024-global-metals-and-mining-outlook.html.
[277] M. Wayland, "Ford and BMW lead $130 million round in EV battery start-up Solid Power", CNBC, 2021, https://cnb.cx/3xes2MQ.
[278] "Global Critical Minerals Outlook 2024", IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024.
[279] V. Balaram, "Chapter 15 - Sustainable Recovery of Rare Earth Elements by Recycling of E-Waste for a Circular Economy: Perspectives and Recent Advances," in *Environmental Materials and Waste (Second Edition)*, ed. Majeti Narasimha Vara Prasad (Elsevier, 2024), 499–544, https://doi.org/10.1016/B978-0-443-22069-2.00023-1.
[280] Levke Albertsen et al., "Circular Business Models for Electric Vehicle Lithium-Ion Batteries: An Analysis of Current Practices of Vehicle Manufacturers and Policies in the EU," *Resources, Conservation and Recycling* 172 (September 1, 2021): 105658, https://doi.org/10.1016/j.resconrec.2021.105658.

decouple economic growth from primary resource extraction.[281] Continued investment in technological innovation, recycling, and international collaboration will meet the increasing demand for critical minerals. Recycling will have a more significant impact in the medium term.

For example, in its 2024 Global Critical Minerals Outlook, the International Energy Agency estimated that a combination of recycling, the use of smaller electric vehicle batteries and the adoption of alternative battery chemistries could reduce demand for lithium by as much as 25 percent by 2030, while recycling can reduce the demand for newly mined copper and cobalt by 30 percent, and lithium and nickel by 15 percent by 2040.[282] The exact accuracy of these forecasts is important but belies the key overarching point: critical mineral demand is highly uncertain in the long-term and supplies from nodules in the deep sea are not needed to meet demand in the short term. Rushing from the exploration phase to exploitation is not an imperative in this context. The following case study looks at these issues in the context of electric vehicle batteries.

Electric Vehicle (EV) Batteries

The exponential growth in EV production is one of the biggest drivers of critical minerals demand.[283] However, battery technologies for EVs are evolving rapidly. Changes in composition over the previous decade alone demonstrate the pace of this change. Significant technological advancements and shifts towards a circular economy have begun reducing dependency on some critical minerals, particularly cobalt and nickel, in EV supply chains. Innovations such as lithium-iron-phosphate (LFP) batteries, which require no cobalt or nickel, have dramatically increased their market share, rising to 31 percent globally by 2022 and projected to reach 60 percent by 2030. This had the effect of dramatically reducing cobalt demand. Similarly, emerging technologies like sodium-ion and solid-state batteries present further opportunities to significantly reduce or eliminate reliance on constrained minerals.

From an industry perspective, alternatives to conventional batteries will continue to proliferate. Tesla, Ford and Volkswagen are all in the process of adopting LFP technology. Chinese EV company BYD, the largest EV manufacturer in the world is removing cobalt, nickel and manganese entirely from its vehicle batteries.[284]

Recycling and circular economy strategies for electric vehicles are also gaining momentum. Improved battery recycling technologies now allow recovery rates exceeding 90 percent for nickel, cobalt, copper, and even 80 percent for lithium. The combined effect of recycling, technology innovation, and circular economy strategies could reduce cumulative mineral

[281] Vlado Vivoda, "Uncharted Depths: Navigating the Energy Security Potential of Deep-Sea Mining," *Journal of Environmental Management* 369 (October 1, 2024): 122343, https://doi.org/10.1016/j.jenvman.2024.122343.
[282] "Global Critical Minerals Outlook 2024", IEA, May 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024.
[283] "Global EV Outlook 2024 – Analysis," IEA, April 23, 2024, https://www.iea.org/reports/global-ev-outlook-2024.
[284] Casey Crowhart, "What's next for Batteries," MIT Technology Review, January 4, 2023, https://www.technologyreview.com/2023/01/04/1066141/whats-next-for-batteries/.

demand by up to 58 percent between 2022 and 2050.[285] A combination of the success of new EV batteries, the experimentation with battery composition, and the proliferation of battery-recycling solutions significantly reduces the imperative for deep-sea mining to support the EV market.

Circular Economy

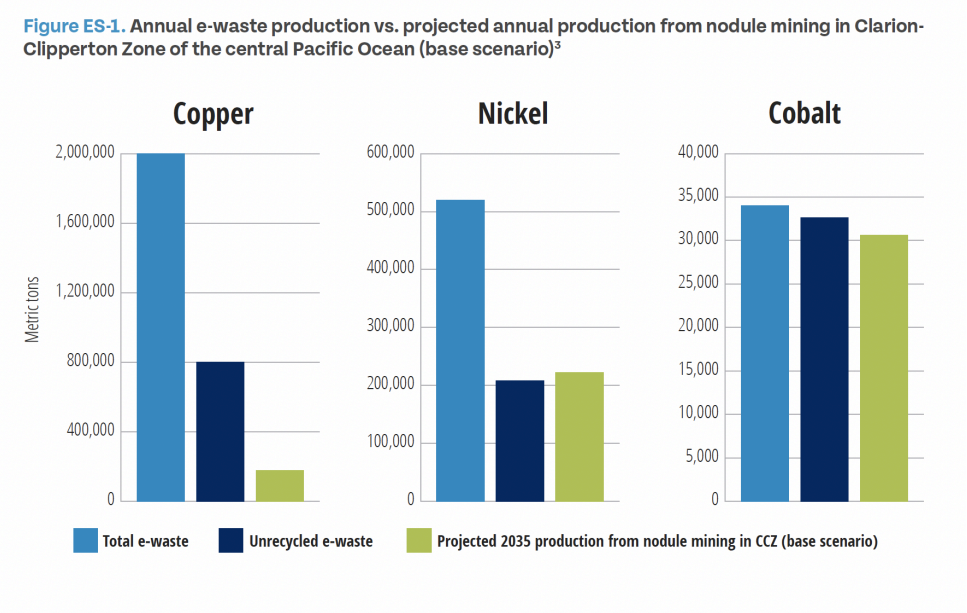
Analysts ranging from the International Energy Agency to the Energy Transitions Commission agree that circular economy strategies will significantly reduce demand for critical minerals over the next decade and beyond. The Energy Transitions Commission found in 2023 that circular economy strategies could close projected supply gaps for copper and nickel, and significantly narrow them for lithium, cobalt and neodymium by 2030.

Electronic waste is rich in critical minerals. For example, 62 million metric tons of electronic waste was created across the world in 2022. Of this, only 22 percent was properly recycled, but the wasteload contained enough copper to meet 14 percent of the forecast annual global energy transition demand in 2035; 31 percent of 2035 energy transition demand for nickel; 13 percent of cobalt demand; and 12 percent of neodymium demand. To give further scale, over 3 million metric tons of unrecycled e-waste was created in the United States alone. Figure 2 below gives a sense of the global scale.

Waste is therefore an extremely important and untapped source of valuable minerals.[286] Extending the lifetimes of electronics, clean energy technologies, and other products throughout our economy can reduce demand for critical minerals. For example, extending the lifetime of a product by 50 percent can reduce material needs by as much as a third, while doubling a product's lifetime can reduce material needs by as much as 50 percent.

[285] Moana Silva Simasm, Fabian Rocha Aponte and Kirsten Svenja Wiebe, "The Future is Circular: Circular Economy and Critical Minerals for the Green Transition. SINTEF". 2022, https://www.sintef.no/en/publications/publication/2073636/#:~:text=It%20focuses%20on%20seven%20critical,earth%20 elements%2C%20platinum%20and%20copper.
[286] Cornelis Baldé et al., "GEM 2024 18-03", 2024, https://www.researchgate.net/publication/379226356_GEM_2024_18-03_web_page_per_page_web

Figure 2: Annual e-waste production cs projected annual production from nodule mining in CCZ (base scenario)[287]



Conclusion

This chapter has shown that deep-sea mining is not essential for fulfilling the critical mineral needs of the global energy transition, especially in the short term. Combined with the risk of disturbance to ecosystems from the lack of sophistication in mining operations, there is little justification for rushing into deep-sea mining. Further, the extreme volatility in the key minerals found in polymetallic nodules of the CCZ, both for project viability (and therefore royalties) and for matching supply-demand forecasts, also detract from the short term imperative to move from exploration to exploitation. Terrestrial resources, technological advancements, and circular economy initiatives encouraging recycling of materials provide a pathway to a sustainable alternative to deep-sea extraction.

[287] Cornelis Baldé et al., "GEM 2024 18-03", 2024, https://www.researchgate.net/publication/379226356_GEM_2024_18-03_web_page_per_page_web

Conclusion

Our research demonstrated that deep-sea mining poses significant economic, legal, environmental, and social risks. While the industry is presented as a lucrative development opportunity, these risks will likely outweigh its speculative economic benefits. The evidence reviewed in the first two chapters of this report challenged the development narrative, showing that economic uncertainties, unresolved legal liabilities, and the possibility of lasting environmental and human harm require a cautious, rules-based and science-based approach to any exploitation of the deep seabed. The third chapter further showed that the claim that deep-sea mining is essential to meet the demand of the global energy transition is not supported by current data, and that safer alternatives for mineral supply remain available.

Deep-sea mining is an issue of global importance; French Polynesia happens to be closest to it. The coming months will set the precedent for how the world engages with this industry. The goal of this work is to equip French Polynesia–a nation with profound ties to the ocean and the largest exclusive economic zone in the Pacific–to be a leader on this issue, and perhaps bring together the Pacific Island nations that have the most to lose.

Economic & Financial Risks of Deep-Sea Mining

Commodity market volatility creates short, medium, and long-term price risks for deep-sea mining investments

- The commercial viability of deep-sea mining depends on market prices, and a decline in mineral prices could lead to a loss of expected revenues and undermine the entire economic case for investment.
- Prices for minerals and metals fluctuate. Minerals like nickel, cobalt, copper, and lithium are traded in highly volatile global commodity markets.

Deep-sea mining within EEZs poses high fiscal risks with limited public returns

- High upfront costs for infrastructure and regulatory development could also result in stranded assets, which would be particularly damaging for Pacific countries with limited fiscal buffers and high debt burdens. Weak tax regimes, offshore corporate structures, and underestimated environmental liabilities often reduce projected government revenue.

Deep-sea mining could trigger "Dutch Disease" in Pacific economies and lead to the appreciation of exchange rates and reduction in the competitiveness of key export sectors like fisheries and tourism

- These sectors are central to economic resilience in the Pacific and rely on stable prices and a healthy environment. Even modest mining windfalls can shift labor and capital away from key industries. This would weaken economic diversity at a time when Pacific nations need it most to manage climate risks, debt, and external shocks.

Conventional cost-benefit analyses (CBAs) fail to capture deep-sea mining's uncertainties

- Standard CBAs overlook critical uncertainties such as price volatility, environmental risks, and the financial fragility of mining firms. The SPC's 2016 analysis, for example, used a static model that underestimated ecological impacts, financial vulnerabilities, and the risks for small states relying on singular mining ventures.

State Liability and Regulatory Risks

The current liability regime for deep-sea mining is not fit for purpose and fails to protect Pacific states and their citizens

- The considerable scientific uncertainty surrounding deep-sea mining poses major challenges in ensuring that risks, burdens, and liabilities are fairly distributed. As a result, there is a significant risk that these responsibilities may ultimately fall on the governments of Pacific states, their citizens, and other stakeholders who rely on and are closely connected to the marine environment.

Deep-sea mining poses a risk of costly investment disputes, which may undermine a state's capacity to regulate the industry's environmental impacts

- Engaging in deep-sea mining activities may leave Pacific states vulnerable to substantial financial liabilities if future policy adjustments prompt investor disputes.

Government settlements following investor litigation over mining laws

Nation	Amount of compensation claimed	Amount awarded	Reason
Ecuador	$3.37 billion	$1.77 billion (reduced to $1.06 billion)	Ecuador terminated Occidental's oil contract for alleged breach of contractual concerns (and also environmental concerns).
Peru	$522 million	$18.2 million in damages plus interest	Concerned about the revocation of the mining decree after significant protests. The company awarded sunk costs despite a lack of an approved EIA.
Costa Rica	$41 million	$16.06 million plus compound interest ($20 million total)	Concerned about the purchase of land to develop a resort. Costa Rica expropriated the land to create a national park, citing environmental and public interest grounds, delay in payment of compensation.
Mexico	$90 million	$16 million in damages plus interest	Refusal of landfill permit due to environmental concerns.

Environmental Risks of Deep-Sea Mining

Is Deep-Sea Mining "Clean"?

Deep-sea mining (DSM) has been positioned as a more sustainable and "clean" alternative to land mining. A growing body of scientific evidence challenges this claim. DSM can have significant environmental impacts. Initial studies assessing the long-term impacts of small-scale experimental mining show that mining disturbances drastically alter ecosystem functioning.

Great uncertainty exists and scientific knowledge gaps are vast

- There are fundamental scientific uncertainties and complexities of deep-sea ecosystems. New information, such as the discovery of dark oxygen, highlights this uncertainty and the substantial risks of exploiting the deep sea.
- One study interviewing scientists found that the vast majority believe:
  - that current scientific knowledge is too sparse to ensure protection of the marine environment from impacts of DSM; and
  - it will take between 6-20 years to build the necessary knowledge to adequately understand and protect the marine environment.

Monitoring damage and establishing baselines is extremely difficult

- Environmental risks from DSM are characterized by high uncertainty, prolonged ecological disruption, and irreversible habitat loss.
- The current techniques for DSM make identifying and monitoring damage extremely difficult, especially compared to terrestrial mining.
- The subterranean location of mining creates greater risks. We may be unaware of damage at the time it occurs and monitoring is very difficult. These issues make DSM riskier than terrestrial mining in many respects.

The *precautionary principle* is the best way forward: more information is required before advancing to the exploitation of the deep sea

Given current knowledge and technological capabilities, DSM **cannot** be conducted in a genuinely "clean" or "harmless" manner.

A sustainable and precautionary approach to DSM should be adopted.

This approach requires significant advances in ecological understanding, robust baseline data, and proven mitigation technologies. None of these currently exist at the necessary scale or effectiveness to comfortably allow for exploitation to occur.

The Demand for Critical Minerals in the Energy Transition

The global energy transition is expected to significantly increase demand for critical minerals

- The transition will be both mineral and metal intensive.
- The global shift towards renewable energy systems includes demand for wind turbines, solar photovoltaics (PV), electric vehicles (EVs), and battery storage. These technologies rely significantly on various combinations of critical minerals.

Deep-Sea Mining is <u>not</u> needed to meet the short-term supply of critical minerals for battery demand

- Land-based extraction can adequately meet the demand for key minerals. This view is commonly held within the industry. [Footnote 1]
- Deep-sea mining would not meaningfully alleviate the short-term supply constraints of the global critical minerals markets of copper. The supply of nickel and cobalt will meet demand until at least 2030. [Footnote 2]
- A circular economy for minerals decreases demand for newly mined minerals. E-waste recycling alone could meet demand in the medium-long term.

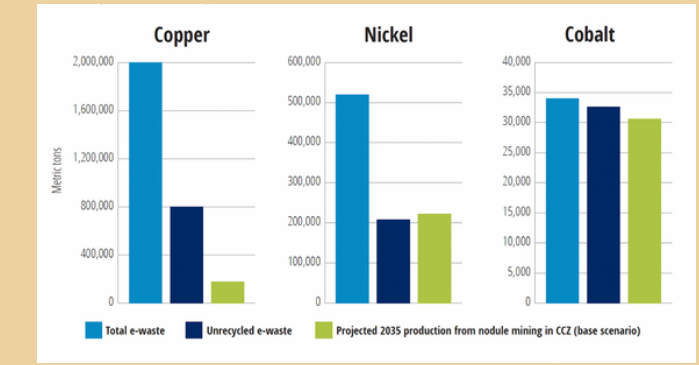


Figure 1: Annual e-waste production cs projected annual production from nodule mining in CCZ (base scenario) [Footnote 4]

Emerging battery chemistries reduce the need for deep-sea minerals after 2030

- Technological innovations promise to lower costs and increase the adoption of clean energy technologies while dramatically altering demand forecasts.
- A World Bank study concluded that batteries are the fastest changing technology sector, making it virtually impossible to forecast which technology will be the most used from now until 2050. [Footnote 3]
- The rapid pace of innovation in these technologies and potential for alternatives reduces the immediate necessity of deep-sea mining.

References

1. Trevor Hart and Ugo Platania, "KPMG 2024 Global Metals and Mining Outlook," KPMG, 2024
2. International Energy Agency, "Global Critical Minerals Outlook 2024," IEA, May 17, 2024.
3. .World Bank. Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition. Washington, DC: World Bank, 2020.
4. Forti, Vanessa, Kees Baldé, Ruediger Kuehr, and Cornelis Peter Baldé. The Global E-waste Monitor 2024: Understanding the Challenges of the Global E-waste Landscape and Making E-waste Visible. Geneva: International Telecommunication Union, United Nations Institute for Training and Research, United Nations University, and International Solid Waste Association, 2024.

Bibliography

Chapter 1. Economic and Legal Risks

Agnieszka Dołhańczuk-Śródka et al., "Assessment of Natural Radioactivity Levels in Polymetallic Nodules and Potential Health Risks from Deep-Sea Mining," Journal of Hazardous Materials 480 (December 5, 2024): https://doi.org/10.1016/j.jhazmat.2024.136494.

AFP - Agence France Presse, "Companies Slam Delay on Deep-sea Mining Rules," Barrons, January 18, 2025, https://www.barrons.com/news/companies-slam-delay-on-deep-sea-mining-rules-cdc06c14.

Alberto Pecoraro, "Law of the Sea and Investment Protection in Deep Seabed Mining" [2019] MelbJlIntLaw 19; (2019) 20(2) Melbourne Journal of International Law (generally).

Alberto Pecoraro, Hannah Lily, and Pradeep Singh, "The International Seabed Authority and the Push for Exploitation of Deep Seabed Minerals: Does the Doctrine of Legitimate Expectations Apply?," The Journal of World Investment & Trade 25, no. 5–6 (November 22, 2024) https://doi.org/10.1163/22119000-12340344.

Alberto Pecoraro, "UNCLOS and Investor Claims for Deep Seabed Mining in the Area: An Investment Law of the Sea?," GCILS Working Paper Series, November 2020, https://gcils.org/wp-content/uploads/2020/11/GCILS-WP-2020-Paper-5-Pecoraro-Revised.pdf, citing, generally: Laura Kaikkonen et al, "Assessing the Impacts of Seabed Mineral Extraction in the Deep Sea and Coastal Marine Environments: Current Methods and Recommendations for Environmental Risk Assessment' (2018) 135 Marine Pollution Bulletin 1183.

"Amending Directives (EU) 2022/2464 and (EU) 2024/1760 as Regards the Dates from Which Member States Are to Apply Certain Corporate Sustainability Reporting and Due Diligence Requirements - Thursday, 3 April 2025," europarl.europa.eu, accessed April 23, 2025, https://www.europarl.europa.eu/doceo/document/TA-10-2025-0064_EN.html.

Article L225-102-1 - Code de commerce - Légifrance, accessed April 23, 2025, https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000047926145.

Article 1833 - Code civil - Légifrance, accessed April 23, 2025, https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000038589931.

Ashford et al.; U. S. Government Accountability Office, "Deep-Sea Mining Could Help Meet Demand for Critical Minerals, But Also Comes with Serious Obstacles | U.S. GAO," September 12, 2024, https://www.gao.gov/blog/deep-sea-mining-could-help-meet-demand-critical-minerals%2C-also-comes-serious-obstacles.

Bear Creek Mining v. Peru, ICSID Case No. ARB/14/21.

Caleb Fotheringham, "Deep-Sea Mining 'great Opportunity' for Cook Islands - Exploration Company," RNZ, September 20, 2023, https://www.rnz.co.nz/international/pacific-news/498386/deep-sea-mining-great-opportunity-for-cook-islands-exploration-company.

Chapitre III : La réparation du préjudice écologique (Articles 1246 à 1252) - Légifrance, accessed April 23, 2025, https://www.legifrance.gouv.fr/codes/section_lc/LEGITEXT000006070721/LEGISCTA000033019029/.

"Code Des Mines et Des Activités Extractives de La Polynésie française", Lexpol, accessed May 1, 2025, https://lexpol.cloud.pf/LexpolAfficheTexte.php?texte=581578.

"Code de l'environnement," DIREN, art. LP. Accessed May 15, 2025, https://www.service-public.pf/diren/partager/code/.

Colin Filer, Mathew Allen, Jennifer Gabriel, "How PNG lost US$120 million and the future of deep-sea mining", Dev Policy Blog, April 2020, https://devpolicy.org/how-png-lost-us120-million-and-the-future-of-deep-sea-mining-20200428/

Compañia del Desarrollo de Santa Elena S.A. v. Republic of Costa Rica, ICSID Case No. ARB/96/1.

Copper Mesa Mining Corp. v Ecuador, PCA Case No. 2012-02, Award, March 15, 2016

"Corporate Sustainability Index (ISE B3) | B3", accessed 16 April 2025, https://www.b3.com.br/en_us/market-data-and-indices/indices/sustainability-indices/corporate-sustainability-index-ise-b3.htm.

David Aingimea to Olav Myklebust, "Addition of Agenda Item to the March 2025 Council Agenda: Process for Consideration of Applications for Plans of Work for Exploration in the Absence of Adopted Exploitation Regulations," November 12, 2024, https://www.isa.org.jm/wp-content/uploads/2024/11/Nauru-Letter-to-ISA-Council-President-re-Process-for-Plan-of-Work_10112024.pdf.

David Bosco, Aline Jaeckel, and Pradeep Singh, *Ready to Regulate? The International Seabed Authority on the Brink of Commercial Mining* (Bloomington, IN: Ostrom Workshop, 2023), https://ostromworkshop.indiana.edu.

"Draft Regulations on Exploitation of Mineral Resources in the Area," ISBA/29/C/CRP.1, February 16, 2024, accessed April 15, 2025, https://www.isa.org.jm/wp-content/uploads/2024/02/Consolidated_text.pdf.

Daniel Wilde, Hannah Lily, Neil Craik, and Anindita Chakraborty, "Equitable sharing of deep-sea mining benefits: More questions than answers", March 2023, Marine Policy, https://www.sciencedirect.com/science/article/pii/S0308597X23000994#sec0015.

"Decision of the Council of The Authority Concerning the Rules of Procedure of the Legal and Technical Commission", accessed 16 April 2025, https://www.isa.org.jm/wp-content/uploads/2023/05/isba_6_c_9_rop_of_ltc.pdf.

Decision of the Assembly of the International Seabed Authority relating to the final report on the first periodic review of the international regime of the Area pursuant to article 154 of the United Nations Convention on the Law of the Sea", 4 April 2023, https://www.isa.org.jm/documents/isba-23-a-13/.

"Directive - 2022/2464 - EN - CSRD Directive - EUR-Lex," EUR, accessed April 23, 2025, https://eur-lex.europa.eu/eli/dir/2022/2464/oj/eng.

Dodd-Frank Wall Street Reform and Consumer Protection Act, Pub. L. No. 111-203, 124 Stat. 1376 (2010).

"Draft Regulations on Exploitation of Mineral Resources in the Area," ISBA/29/C/CRP.1, February 16, 2024, accessed April 15, 2025, https://www.isa.org.jm/wp-content/uploads/2024/02/Consolidated_text.pdf.

Edmond Campbell, "Jamaica Not Liable for Deep-Sea Mining Company's Exploration, Says Johnson Smith", accessed 15 April 2025, https://jamaica-gleaner.com/article/lead-stories/20241111/jamaica-not-liable-deep-sea-mining-companys-exploration-says-johnson.

E.I. van Putten, S. Aswani, W.J. Boonstra, R. De la Cruz-Modino, J. Das, M. Glaser, N. Heck, S. Narayan, A. Paytan, S. Selim & R. Vave, "History matters: societal acceptance of deep-sea mining and incipient conflicts in Papua New Guinea", 2023, Nature, https://link.springer.com/article/10.1007/s40152-023-00318-0

Elizabeth R. Selig et al., "Revealing Global Risks of Labor Abuse and Illegal, Unreported, and Unregulated Fishing," Nature Communications 13, no. 1 (April 5, 2022): https://doi.org/10.1038/s41467-022-28916-2.

Emma Amadi and François Mosnier, "Mining for Trouble, Planet Tracker", https://planet-tracker.org/wp-content/uploads/2024/11/Mining-for-Trouble.pdf.

Environment Protection and Biodiversity Conservation Act 1999 (Cth), Compilation No. 64, registered April 11, 2025.

"Environmental Restoration Program," Naval Facilities Engineering Systems Command, accessed April 22, 2025, https://www.navfac.navy.mil/Divisions/Environmental/Products-and-Services/Environmental-Restoration/

Eric Lipton, "Fight Over Seabed Agency Leadership Turns Nasty", New York Time, 4 July 2024, https://www.nytimes.com/2024/07/04/us/politics/seabed-agency-mining.html.

"Exploration Contracts," International Seabed Authority, March 25, 2025, https://www.isa.org.jm/exploration-contracts/.

Exploration (Kiribati) Marawa Research, "Application for approval of a plan of work for exploration for polymetallic nodules in the Area by Marawa Research and Exploration Ltd. : executive summary", 11 June 2012, https://digitallibrary.un.org/record/729862.

"France | International Investment Agreements Navigator | UNCTAD Investment Policy Hub," n.d., https://investmentpolicy.unctad.org/international-investment-agreements/countries/72/france.

Gabriel Resources v. Romania, ICSID Case No. RB/15/31.

Gracelin Baskaran, "Drivers of Base Metals Price Volatility", June 2024, CSIS, https://www.csis.org/analysis/drivers-base-metals-price-volatility.

Gracelin Baskaran and Meredith Schwartz, "The Consequences of China's New Rare Earths Export Restrictions", April 2025, CSIS, https://www.csis.org/analysis/consequences-chinas-new-rare-earths-export-restrictions.

"GRI - The Reporting Landscape", accessed 16 April 2025, https://www.globalreporting.org/public-policy/the-reporting-landscape/.

"GRI - GRI Standards English Language", accessed 16 April 2025, https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/.

"GRI Standards and Reporting | GRI Explained | Workiva Carbon", accessed 16 April 2025, https://www.sustain.life/blog/gri-standards.

Hoe Ee Khor, Roger P. Kronenberg, and Patrizia Tumbarello, "Resilience and Growth in the Small States of the Pacific", August 2016, International Monetary Fund, https://www.imf.org/en/Publications/Books/Issues/2017/03/24/Resilience-and-Growth-in-the-Small-States-of-the-Pacific-42684

IEA, "Critical Minerals Outlook", 2024, https://iea.blob.core.windows.net/assets/ee01701d-1d5c-4ba8-9df6-abeeac9de99a/GlobalCriticalMineralsOutlook2024.pdf.

IEA "Recycling of Critical Minerals", 2024, https://www.iea.org/reports/recycling-of-critical-minerals/executive-summary

"IFRS - International Sustainability Standards Board", accessed 16 April 2025, https://www.ifrs.org/groups/international-sustainability-standards-board/#resources.

Ilya Epikhin, Carlo Stella, Amer Hage Chahine, et al., "Seabed mining: A $20 trillion opportunity", August 2024, https://www.adlittle.com/en/insights/viewpoints/seabed-mining-20-trillion-opportunity

International Seabed Authority. *Exploration Contracts*. Accessed May 20, 2025. https://www.isa.org.jm/exploration-contracts/.

International Seabed Authority. Polymetallic Nodule Mining Technology: Proceedings of the Workshop Held in Chennai, India, 19–22 September 2023. Kingston, Jamaica: International Seabed Authority, 2023. https://www.isa.org.jm/wp-content/uploads/2023/10/chennai-19sept-final.pdf.

"Information Sensitivity, Classification and Handling | HR Portal", accessed 16 April 2025, https://hr.un.org/content/information-sensitivity-classification-and-handling.

"ISBA/5/FC/1 - International Seabed Authority", 18 July 2022, https://www.isa.org.jm/mining_code/isba-5-fc-1/.

ISA Contract for Exploration – Public Information Template, accessed April 23, 2025, https://www.isa.org.jm/wp-content/uploads/2022/10/Public-information-on-contracts-COMRA_CFC.pdf.

ISA, "Equitable sharing of financial and other benefits from deep-sea mining", 2021, https://www.isa.org.jm/wp-content/uploads/2022/06/ISA_Technical_Study_31.pdf.

Jack Pegram, Gioia Falcone, and Athanasios Kolios, "A Review of Job Role Localization in the Oil and Gas Industry," Energies 11, no. 10 (October 2018): https://doi.org/10.3390/en11102779.

James R. Hollyer, B. Peter Rosendorff, and James Raymond Vreeland, "Democracy and Transparency", *The Journal of Politics* 73, no. 4 (2011): https://doi.org/10.1017/s0022381611000880.

"Jantzi Social | Morningstar Indexes", accessed 16 April 2025, https://indexes.morningstar.com/indexes/details/jantzi-social-FS0000ILMP?currency=USD&variant=TR&tab=overview.

Jenik Radon et al., rep., Murkier Waters — The Challenge and Risks of Deep-Sea Mining "Development" (2024).

Jeffrey Allan Ardron, "Good Governance of Deep-Seabed Mining:Transparency and the Monitoring of Environmental Harm" (phd, University of Southampton, 2020), https://eprints.soton.ac.uk/444729/.

Jeff Ardron, Hannah Lily, and Aline Jaeckel, "Public Participation in the Governance of Deep-Seabed Mining in the Area", in Research Handbook on International Marine Environmental Law, ed. Rosemary Rayfuse, Aline Jaeckel, and Natalie Klein (Edward Elgar Publishing, 2023), 361–84, https://doi.org/10.4337/9781789909081.00026.

Jeff A. Ardron, "Transparency in the Operations of the International Seabed Authority: An Initial Assessment", Marine Policy 95 (1 September 2018): 324–31, https://doi.org/10.1016/j.marpol.2016.06.027.

Jessica B. Volz et al., "Alpha Radiation from Polymetallic Nodules and Potential Health Risks from Deep-Sea Mining," Scientific Reports 13, no. 1 (May 17, 2023): https://doi.org/10.1038/s41598-023-33971-w.

Kanae Komaki and David Fluharty, “Options to Improve Transparency of Environmental Monitoring Governance for Polymetallic Nodule Mining in the Area”, *Frontiers in Marine Science* 7 (30 April 2020): 247, https://doi.org/10.3389/fmars.2020.00247.

Kerry Krutilla, David Good, Michael Toman, et al., “Addressing Fundamental Uncertainty in Benefit-Cost Analysis: The Case of Deep Seabed Mining”, Journal of Benefit-Cost Analysis, February 2021 https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/addressing-fundamental-uncertainty-in-benefitcost-analysis-the-case-of-deep-seabed-mining/75801881799BD7EB2D3CF7B33C4DDAC6.

“Lex - 2025_44 - EN - EUR-Lex,” EUR, accessed April 23, 2025, https://eur-lex.europa.eu/procedure/EN/2025_44.

Lisa Sachs, Lise Johnson, and Ella Merrill, “Environmental Injustice: How Treaties Undermine Human Rights Related to the Environment,” January 1, 2020, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3531256, p90.

“Loi N° 2017-399 Du 27 Mars 2017 Relative Au Devoir de Vigilance Des Sociétés Mères et Des Entreprises Donneuses d’ordre (1),” LOI n° 2017-399 du 27 mars 2017 relative au devoir de vigilance des sociétés mères et des entreprises donneuses d’ordre (1) - Légifrance, accessed April 22, 2025, https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000034290626/.

“Loi Organique N° 2004-192 DU 27 Février 2004 Portant Statut d’autonomie de La Polynésie Française (1).,” Loi organique n° 2004-192 du 27 février 2004 portant statut d’autonomie de la Polynésie française (1). - Légifrance, accessed April 22, 2025, https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000435515.

Lone Pine v. Canada, Case No. ICSID, UNCT/15/2.

“Media Release – Canadian Sustainability Standards Board Announces First Canadian Sustainability Disclosure Standards for Public Consultation”, accessed 16 April 2025, https://www.frascanada.ca/en/sustainability/projects/adoption-csds1-csds2/media-release-cssb-public-consultation.

Metalclad v Mexico, ICSID Case No. ARB(AF)/97/1.

“The Mining Code,” International Seabed Authority, June 25, 2024, https://www.isa.org.jm/the-mining-code/.

Mobil and Murphy v. Canada (I), Case No. ARB(AF)/07/4 (ICSID. 2007).

M Rabone et al., “A Review of the International Seabed Authority Database DeepData from a Biological Perspective: Challenges and Opportunities in the UN Ocean Decade”, *Database* 2023 (1 January 2023): baad013, https://doi.org/10.1093/database/baad013.

Nancy Pollock, “Nauru Phosphate History and the Resource Curse Narrative”, Journal de la Société des Oceanistese, 2014, https://nauru-data.sprep.org/resource/nauru-phosphate-history-and-resource-curse-narrative.

"NASDAQ_TMC_2022.Pdf", accessed 16 April 2025, https://www.annualreports.com/HostedData/AnnualReportArchive/t/NASDAQ_TMC_2022.pdf.

Nauru Ocean Resources, "Application for Approval of a Plan of Work for Exploration for Polymetallic Nodules in the Area by Nauru Ocean Resources Incorporated", 21 June 2011, https://digitallibrary.un.org/record/818492.

Occidental v Ecuador, ICSID Case No. ARB/06/11.

The Ocean Foundation and Bobbi-Jo Dobush, rep., *Deep Seabed Mining (DSM) Risk and Liability Considerations*, 2023

Oliver Ashford et al., "What We Know About Deep-Sea Mining — and What We Don't," February 23, 2024, https://www.wri.org/insights/deep-sea-mining-explained.

"Ordonnance N° 2016-131 DU 10 Février 2016 Portant Réforme Du Droit Des Contrats, Du Régime Général et de La Preuve Des Obligations," Ordonnance n° 2016-131 du 10 février 2016 portant réforme du droit des contrats, du régime général et de la preuve des obligations - Légifrance, accessed April 23, 2025, https://www.legifrance.gouv.fr/loda/id/JORFTEXT000032004939

Pascal Gourdon, *CODE CIVIL APPLICABLE EN POLYNÉSIE FRANÇAISE Comprenant La Traduction En Langue Tahitienne d'une Centaine d'articles* (Polydroit, 2023).

Peter Mullins and Lee Burns, "The fiscal regime for deep sea mining in the Pacific region", September 2018, Marine Policy, https://www.sciencedirect.com/science/article/pii/S0308597X16304808.

"'Playing Gods with the Cradle of Life': French Polynesia's President Issues Warning over Deep-Sea Mining," The Guardian, March 31, 2025, https://www.theguardian.com/world/2025/apr/01/french-polynesia-deep-sea-mining-pacific-warning-president-moetai-brotherson.

"Push to Mine Ocean Floor Raises Concerns over International Seabed Authority - Los Angeles Times", accessed 16 April 2025, https://www.latimes.com/politics/story/2022-04-19/gold-rush-in-the-deep-sea-raises-questions-about-international-seabed-authority.

Prof. David Johnson, Prof. Philip Weaver, Dr Vikki Gunn, et al., "Periodic Review of the International Seabed Authority pursuant to UNCLOS Article 154", accessed 16 April 2025, https://www.isa.org.jm/wp-content/uploads/2022/06/isba-22a-crp.3-1.pdf.

Rodrigo Castillo, "China's role in supplying critical minerals for the global energy transition: What could the future hold?", August 2022, https://www.brookings.edu/articles/chinas-role-in-supplying-critical-minerals-for-the-global-energy-transition-what-could-the-future-hold/.

Riley Traut, "Stuck Between a Polymetallic Nodule and a Hard Place: Harmonizing Deep-Sea Mineral Exploitation and Prevention of Harm to the Marine Environment Under the United Nations Convention on the Law of the Sea," *Columbia Journal of Transnational Law*, 2024

"Risky Business: Liability for Deep-Sea Mining Sponsoring States," Deep Sea Conservation Coalition, March 5, 2025, https://deep-sea-conservation.org/resources/risky-business-liability-for-deep-sea-mining-sponsoring-states/.

Rebecca Strating, Sunil Rao, and Sallie Yea, "Human Rights at Sea: The Limits of Inter-State Cooperation in Addressing Forced Labour on Fishing Vessels," Marine Policy 159 (January 1, 2024): 105934, https://doi.org/10.1016/j.marpol.2023.105934.

"Ready to Regulate? The International Seabed Authority on the Brink of Commercial Mining", accessed 15 April 2025, https://dlc.dlib.indiana.edu/dlc/items/b05c8212-2012-4de9-b9d4-bdf3bfdcd5a6.

"Regulation - 2020/852 - EN - Taxonomy Regulation - EUR-Lex," EUR, accessed April 23, 2025, https://eur-lex.europa.eu/eli/reg/2020/852/oj/eng.

"Rules and Regulations", accessed 16 April 2025, https://www.hkex.com.hk/Listing/Sustainability/ESG-Academy/Rules-and-Regulations?sc_lang=en.

"SEC.Gov | The Enhancement and Standardization of Climate-Related Disclosures for Investors", accessed 16 April 2025, https://www.sec.gov/rules-regulations/2024/03/s7-10-22.

"Secret Data, Tiny Islands and a Quest for Treasure on the Ocean Floor - The New York Times", accessed 15 April 2025, https://www.nytimes.com/2022/08/29/world/deep-sea-mining.html.

Shobhan Dhir, Eric Buisson, Tae-Yoon Kim, "Growing geopolitical tensions underscore the need for stronger action on critical minerals security", International Energy Agency, February 2025, https://www.iea.org/commentaries/growing-geopolitical-tensions-underscore-the-need-for-stronger-action-on-critical-minerals-security.

SPC, "An Assessment of the Costs and Benefits of Mining Deep-sea Minerals in the Pacific Island Region: deep-sea Mining Cost-Benefit Analysis", 2016, https://www.sprep.org/attachments/VirLib/Regional/deep-sea-mining-cba-PICs-2016.pdf

"Sustainable Finance Package - European Commission", accessed 16 April 2025, https://finance.ec.europa.eu/publications/sustainable-finance-package_en.

Talatu Akindolire, "Role and Responsibilities of Sponsoring States in Deep Seabed Mining," in *International Seabed Authority*, 2022, https://www.isa.org.jm/wp-content/uploads/2022/12/1_Talatu_Akindolire_ADSR_Abuja_workshop_Day_2.pdf.

Tethyan Copper v. Pakistan, ICSID Case No. ARB/12/1.

"Tonga Offshore Mining Ltd.: Application for Approval of a Plan of Work for Exploration", 14 June 2011, https://digitallibrary.un.org/record/705252.

Traités bilatéraux d'investissement: France/Colombie du 10 juill. 2014, art. 1, § 4.

Valdo F. Rodrigues, Frida Marina Fischer, and Mozar J. Brito, "Shift Work at a Modern Offshore Drilling Rig," J Hum Ergol 30 (2001).

"UNCLOS and Agreement on Annex III, Article 14", accessed 15 April 2025, https://www.un.org/depts/los/convention_agreements/texts/unclos/closindx.htm.

United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994).

Wikipedia contributors, "IFREMER," *Wikipedia*, last modified February 2025, https://en.wikipedia.org/wiki/IFREMER.

The World Bank, "Pacific Economic Update: Diminishing Growth amid Global Uncertainty: Ramping up Investment in the Pacific", 2024, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099101424002525333/p5069571930b360dd1a998151821271584d.

"3rd Part of the 28th Annual Session of the International Seabed Authority", IISD Earth Negotiations Bulletin, 8 August 2017, https://enb.iisd.org/international-seabed-authority-isa-council-28-3.

Chapter 2. Environmental Risks: Review of Scientific Developments and the Relationship to Deep Sea Mining

"Agreement on Part XI UNCLOS," accessed April 16, 2025, https://www.un.org/depts/los/convention_agreements/texts/agreement_part_xi/agreement_part_xi.htm.

Andrew Chin and Katelyn Hari, "Predicting the Impacts of Mining Deep Sea Polymetallic Nodules in the Pacific Ocean," 32, accessed April 15, 2025, https://www.miningwatch.ca/sites/default/files/nodule_mining_in_the_pacific_ocean.pdf.

Amon, Diva J., Craig R. Smith, Ana Colaço, Lenaick Menot, Daniel O. B. Jones, and Pedro Martinez Arbizu. "Assessment of Scientific Gaps Related to the Effective Environmental Management of Deep-Seabed Mining." Marine Policy 138 (April 1, 2022): 105006. https://doi.org/10.1016/j.marpol.2022.105006.

Asanka Edirisinghe and Sandie Suchet-Pearson, "Nature as a Sentient Being: Can Rivers Be Legal Persons?", Review of European, Comparative & International Environmental Law 33, no. 2 (2024), https://onlinelibrary.wiley.com/doi/full/10.1111/reel.12529.

Chris Pickens and et al., “From What-If to What-Now: Status of the Deep-Sea Mining Regulations and Underlying Drivers for Outstanding Issues,” Marine Policy 169 (2024), https://doi.org/10.1016/j.marpol.2023.105967.

Costello, Mark John, Cheung Chi Shing, and Boyle Patrick R. “A Census of Marine Biodiversity Knowledge, Resources, and Future Challenges.” PLOS One 5, no. 8 (August 2, 2010): e12110. https://doi.org/10.1371/journal.pone.0012110.

Deep Sea Conservation Coalition “Deep-Sea Mining: Why Deep-Sea Minerals Are Not Needed,” accessed April 20, 2025, https://deep-sea-conservation.org/resources/deep-sea-mining-why-deep-sea-minerals-are-not-needed/.

“Draft regulations on exploitation of Mineral resources in the Area,” ISBA/29/C/CRP.1, February 16, 2024, accessed April 15, 2025, Regulation No. 2, https://www.isa.org.jm/wp-content/uploads/2024/02/Consolidated_text.pdf.

European Commission “European Battery Alliance,” accessed April 20, 2025, https://single-market-economy.ec.europa.eu/industry/industrial-alliances/european-battery-alliance_en.

Kirsten Hund et al., “Climate-Smart Mining Facility,” n.d.; Daniel O. B. Jones et al., “Biological Responses to Disturbance from Simulated Deep-Sea Polymetallic Nodule Mining,” PLOS ONE 12, no. 2 (February 8, 2017): e0171750, https://doi.org/10.1371/journal.pone.0171750.

Kathryn A. Miller et al., “An Overview of Seabed Mining Including the Current State of Development, Environmental Impacts, and Knowledge Gaps,” Frontiers in Marine Science 4 (January 10, 2018), https://doi.org/10.3389/fmars.2017.00418.

Kristine Sabillo, “Taranaki Maunga, New Zealand Mountain, Declared a “Legal Person””, Mongabay, February 20, 2025, https://news.mongabay.com/short-article/taranaki-maunga-new-zealand-mountain-declared-a-legal-person/.

Elisa Morgera and Hannah Lily, “Public Participation at the International Seabed Authority: An International Human Rights Law Analysis,” WILEY RECIEL, 2022, https://doi.org/10.1111/reel.12472.

“Economic, Social and Cultural Rights,” OHCHR, accessed April 15, 2025, https://www.ohchr.org/en/human-rights/economic-social-cultural-rights.

European Marine Board, "Linking Oceans and Human Health," 23–59, accessed April 15, 2025, https://www.marineboard.eu/sites/marineboard.eu/files/public/publication/Oceans%20and%20Human%20Health-214.pdf.

Graham J. Hamley, "The Implications of Seabed Mining in the Area for the Human Right to Health," Review of European, Comparative & International Environmental Law 31, no. 3 (2022): 390, https://doi.org/10.1111/reel.12471.

Hannah White, "Indigenous Peoples, the International Trend Toward Legal Personhood for Nature, and the United States", American Indian Law Review 43, no. 1 (2018): 151, https://digitalcommons.law.ou.edu/cgi/viewcontent.cgi?article=1695&context=ailr.

"International Covenant on Economic, Social and Cultural Rights", adopted December 16, 1966, General Assembly resolution 2200A (XXI), https://www.ohchr.org/en/instruments-mechanisms/instruments/international-covenant-economic-social-and-cultural-rights.

Liam Koka'ua, "Our Deep Sea Is Being Colonised", E-Tangata, April 2 2023, https://e-tangata.co.nz/comment-and-analysis/our-deep-sea-is-being-colonised/.

Carlos Muñoz-Royo et al., "Extent of Impact of Deep-Sea Nodule Mining Midwater Plumes Is Influenced by Sediment Loading, Turbulence and Thresholds," Communications Earth & Environment 2, no. 1 (July 27, 2021): 1–16, https://doi.org/10.1038/s43247-021-00213-8.

Jeff A. Ardron, Henry A. Ruhl, and Daniel O. B. Jones, "Incorporating Transparency into the Governance of Deep-Seabed Mining in the Area beyond National Jurisdiction," Marine Policy 89 (February 1, 2018): 58–66, https://doi.org/10.1016/j.marpol.2017.11.021.

Jones, Daniel O. B., Andrew K. Sweetman, Craig R. Smith, Ana Colaço, Pedro M. Arbizu, and Lenaick Menot. "Biological Responses to Disturbance from Simulated Deep-Sea Polymetallic Nodule Mining." PLOS ONE 12, no. 2 (February 8, 2017): e0171750. https://doi.org/10.1371/journal.pone.0171750.

Judith Jordens et al., "Appeal to Montreal: Protection for Deep-Sea Species," Senckenberg Society for Nature Research, December 7, 2022, https://www.senckenberg.de/en/pressemeldungen/appeal-to-montreal-protection-for-deep-sea-species/.

Julie Hunter, Pradeep Singh, and Julian Aguon, "Broadening Common Heritage: Addressing Gaps in the Deep Sea Mining Regulatory Regime," Harvard Environmental Law Review, April 16, 2018, 3, https://www.researchgate.net/publication/326518886_Broadening_Common_Heritage_Addressing_Gaps_in_the_Deep_Sea_Mining_Regulatory_Regime.

Muñoz-Royo, Carlos, Ana Colaço, Daniel O. B. Jones, Diva J. Amon, and Craig R. Smith. "Extent of Impact of Deep-Sea Nodule Mining Midwater Plumes Is Influenced by Sediment Loading, Turbulence and Thresholds." Communications Earth & Environment 2, no. 1 (July 27, 2021): 1–16. https://doi.org/10.1038/s43247-021-00213-8.

Muñoz-Royo, Carlos, Ana Colaço, Daniel O. B. Jones, Diva J. Amon, and Craig R. Smith. "Extent of Impact of Deep-Sea Nodule Mining Midwater Plumes Is Influenced by Sediment Loading, Turbulence and Thresholds." Communications Earth & Environment 2, no. 1 (July 27, 2021): 1–16. https://doi.org/10.1038/s43247-021-00213-8.

Stefanie Kaiser et al., "Diving through the Darkness; Species Information Is Vital for Effective Marine Conservation [Senckenberg Policy Brief - Appeal to Montreal]," December 6, 2022, https://doi.org/10.5281/zenodo.7410159.

Holly J. Niner et al., "Deep-Sea Mining With No Net Loss of Biodiversity—An Impossible Aim," Frontiers in Marine Science 5 (March 1, 2018), https://doi.org/10.3389/fmars.2018.00053.

Monica Evans, "Is 'Legal Personhood' a Tool or a Distraction for Maori Relationships with Nature?," Mongabay, July 2024, https://news.mongabay.com/2024/07/as-maori-heal-through-nature-is-legal-personhood-a-tool-or-a-distraction//.

Muriel Rabone et al., "How Many Metazoan Species Live in the World's Largest Mineral Exploration Region?," Current Biology 33, no. 12 (June 19, 2023): 2383-2396.e5, https://doi.org/10.1016/j.cub.2023.04.052.

Kirsten F. Thompson et al., "Urgent Assessment Needed to Evaluate Potential Impacts on Cetaceans from Deep Seabed Mining," Frontiers in Marine Science 10 (February 14, 2023), https://doi.org/10.3389/fmars.2023.1095930.

"Open Letter by the Working Group on the Issue of Human Rights and Transnational Corporations and Other Business Enterprises, the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes and the Special Rapporteur on the Issue of Human Rights Obligations Relating to the Enjoyment of a Safe, Clean, Healthy and Sustainable Environment," (2024) accessed April 15, 2025, https://www.isa.org.jm/wp-content/uploads/2024/05/Letter-SPB-ISA.pdf.

Ronald O'Dor, Darlene T. Crist, Andrea Ottensmeyer, "Census of Marine Life - an Overview | ScienceDirect Topics," accessed April 20, 2025, https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/census-of-marine-life.

Samuel B Stratton, "Incorporating the Environment? Critiquing the Law's Structural Bias Against Nature and in Favor of Business Interests", SJP 1 (n.d.),

https://systemicjustice.org/article/incorporating-the-environment-critiquing-the-laws-structural-bias-against-nature-and-in-favor-of-business-interests/.

Sweetman, A.K., Smith, A.J., de Jonge, D.S.W. et al. "Evidence of Dark Oxygen Production at the Abyssal Seafloor | Nature Geoscience," accessed April 20, 2025, https://www.nature.com/articles/s41561-024-01480-8.

'Te Awa Tupua (Whanganui River Claims Settlement) Act', Pub. L. No. 2017 No 7 (2017), https://www.legislation.govt.nz/act/public/2017/0007/latest/whole.html.

Tamatoa Bambridge, ed., The Rahui: Legal Pluralism in Polynesian Traditional Management of Resources and Territories (ANU Press, 2016), https://library.oapen.org/bitstream/handle/20.500.12657/32723/607554.pdf;jsessionid=D350735E2E9EAAEEE1EA73C51CF5368A?sequence=1.

"The Human Right to a Clean, Healthy and Sustainable Environment" (2022), United Nations General Assembly, Resolution 76/300, https://digitallibrary.un.org/record/3983329.

"The Mining Code: Draft Exploitation Regulations - International Seabed Authority," March 17, 2022, https://www.isa.org.jm/the-mining-code/draft-exploitation-regulations-2/.

Thompson, Kirsten F. et al., "Seabed Mining and Approaches to Governance of the Deep Seabed," Frontiers in Marine Science 5 (December 11, 2018), https://doi.org/10.3389/fmars.2018.00480.

"Towards a Universal Declaration of Ocean Rights (UDOR): Concept Note", 2023, https://static1.squarespace.com/static/55914fd1e4b01fb0b851a814/t/646523cd9c8b6d4f55abaa3c/1684349908559/UDOR_Concept+Note+%281%29.pdf

United Nations Environment Program, "Harmful Marine Extractives: Deep-Sea Mining," June 2022, https://www.unepfi.org/publications/harmful-marine-extractives-deep-sea-mining/.

United Nations, "United Nations Convention on the Law of the Sea," Pub. L. No. U.N.T.S. 397 (1994).

Van Dover, C. L. et al., "Biodiversity Loss from Deep-Sea Mining," Nature Geoscience 10, no. 7 (July 2017): 464–65, https://doi.org/10.1038/ngeo2983.

Viktoria Kahui, "Granting Legal "Personhood" to Nature Is a Growing Movement – Can It Stem Biodiversity Loss?", The Conversation, 25 April 2024, https://theconversation.com/granting-legal-personhood-to-nature-is-a-growing-movement-can-it-stem-biodiversity-loss-227336.

Ann Vanreusel et al., “Threatened by Mining, Polymetallic Nodules Are Required to Preserve Abyssal Epifauna,” Scientific Reports6, no. 1 (June 1, 2016): 26808, https://doi.org/10.1038/srep26808.

Chapter 3. Energy Transition: The Use of Critical Minerals in the Energy Transition – A Need For Deep Sea Minerals?

Crowhart, Casey. “What’s Next for Batteries.” MIT Technology Review, January 4, 2023. https://www.technologyreview.com/2023/01/04/1066141/whats-next-for-batteries/. International Energy Agency.

“Executive Summary – The Role of Critical Minerals in Clean Energy Transitions: World Energy Outlook.” IEA, May 2021. https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary.

International Energy Agency. “Global EV Outlook 2024 – Analysis.” IEA, April 23, 2024. https://www.iea.org/reports/global-ev-outlook-2024.
International Energy Agency. “Mineral Requirements for Clean Energy Transitions – The Role of Critical Minerals in Clean Energy Transitions – Analysis.” Accessed April 22, 2025. https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/mineral-requirements-for-clean-energy-transitions.

V. Balaram, “Chapter 15 - Sustainable Recovery of Rare Earth Elements by Recycling of E-Waste for a Circular Economy: Perspectives and Recent Advances,” in Environmental Materials and Waste (Second Edition), ed. Majeti Narasimha Vara Prasad (Elsevier, 2024), 499–544, https://doi.org/10.1016/B978-0-443-22069-2.00023-1.

Casey Crowhart, “What’s next for Batteries,” MIT Technology Review, January 4, 2023, https://www.technologyreview.com/2023/01/04/1066141/whats-next-for-batteries/.

Trevor Hart and Ugo Platania, “KPMG 2024 Global Metals and Mining Outlook,” KPMG, 2024, https://kpmg.com/xx/en/our-insights/risk-and-regulation/kpmg-2024-global-metals-and-mining-outlook.html.

International Energy Agency, “Mineral Requirements for Clean Energy Transitions – The Role of Critical Minerals in Clean Energy Transitions – Analysis,” IEA, accessed April 22, 2025, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/mineral-requirements-for-clean-energy-transitions.

International Energy Agency, “Executive Summary – The Role of Critical Minerals in Clean Energy Transitions -- World Energy Outlook,” IEA, May 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary.

International Energy Agency, “Global EV Outlook 2024 – Analysis,” IEA, April 23, 2024, https://www.iea.org/reports/global-ev-outlook-2024.

International Energy Agency, “Global Critical Minerals Outlook 2024 – Analysis,” IEA, May 17, 2024, https://www.iea.org/reports/global-critical-minerals-outlook-2024.

International Energy Forum, “IEF Critical Minerals Outlooks Comparison,”, accessed April 20, 2025, https://www.ief.org/focus/ief-reports/critical-minerals-outlooks-comparison.

International Renewable Energy Agency, “Geopolitics of the Energy Transition: Critical Materials,” April 18, 2024, https://www.irena.org/Digital-Report/Geopolitics-of-the-Energy-Transition-Critical-Materials.

International Telecommunication Union “The Global E-Waste Monitor 2024,” 2024, https://www.itu.int:443/en/ITU-D/Environment/Pages/Publications/The-Global-E-waste-Monitor-2024.aspx.

Éléonore Lèbre et al., “Mining on Land or in the Deep Sea? Overlooked Considerations of a Reshuffling in the Supply Source Mix,” Resources, Conservation and Recycling 191 (April 1, 2023): 106898, https://doi.org/10.1016/j.resconrec.2023.106898.

Levke Albertsen et al., “Circular Business Models for Electric Vehicle Lithium-Ion Batteries: An Analysis of Current Practices of Vehicle Manufacturers and Policies in the EU,” Resources, Conservation and Recycling 172 (September 1, 2021): 105658, https://doi.org/10.1016/j.resconrec.2021.105658.

McKinsey, “Lithium-Ion Battery Demand Forecast for 2030,” accessed April 20, 2025, https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/battery-2030-resilient-sustainable-and-circular.

Moana Silva, Simas Fabian Rocha Aponte, Kirsten Svenja Wiebe “The Future Is Circular - Circular Economy and Critical Minerals for the Green Transition,” SINTEF, accessed April 20, 2025, https://www.sintef.no/en/publications/publication/2073636/.

Sarah M. Hayes and Erin A. McCullough, “Critical Minerals: A Review of Elemental Trends in Comprehensive Criticality Studies,” Resources Policy, Sustainable management and exploitation of extractive waste: towards a more efficient resource preservation and waste recycling, 59 (December 1, 2018): 192–99, https://doi.org/10.1016/j.resourpol.2018.06.015.

V. Balaram. “Sustainable Recovery of Rare Earth Elements by Recycling of E-Waste for a Circular Economy: Perspectives and Recent Advances.” In Environmental Materials and Waste (Second Edition), edited by Majeti Narasimha Vara Prasad, 499–544. Elsevier, 2024. https://doi.org/10.1016/B978-0-443-22069-2.00023-1.

Hund Richard, Kirsten Lori Arrobas, Daniele La Porta, Fabregas Masllovet, Thao Phuong Laing, Timothy James, Drexhage, John, “Minerals for Climate Action : The Mineral Intensity of the Clean Energy Transition,” Text/HTML, World Bank, May 24, 2023, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/en/099052423172525564.

Hannah Ritchie, “We Have Enough Minerals for the Energy Transition, but Medium-Term Supply Is a Challenge [Part 1],” November 18, 2024, https://www.sustainabilitybynumbers.com/p/transition-mineral-demand-part-one.

Vlado Vivoda, “Uncharted Depths: Navigating the Energy Security Potential of Deep-Sea Mining,” Journal of Environmental Management 369 (October 1, 2024): 122343, https://doi.org/10.1016/j.jenvman.2024.122343.