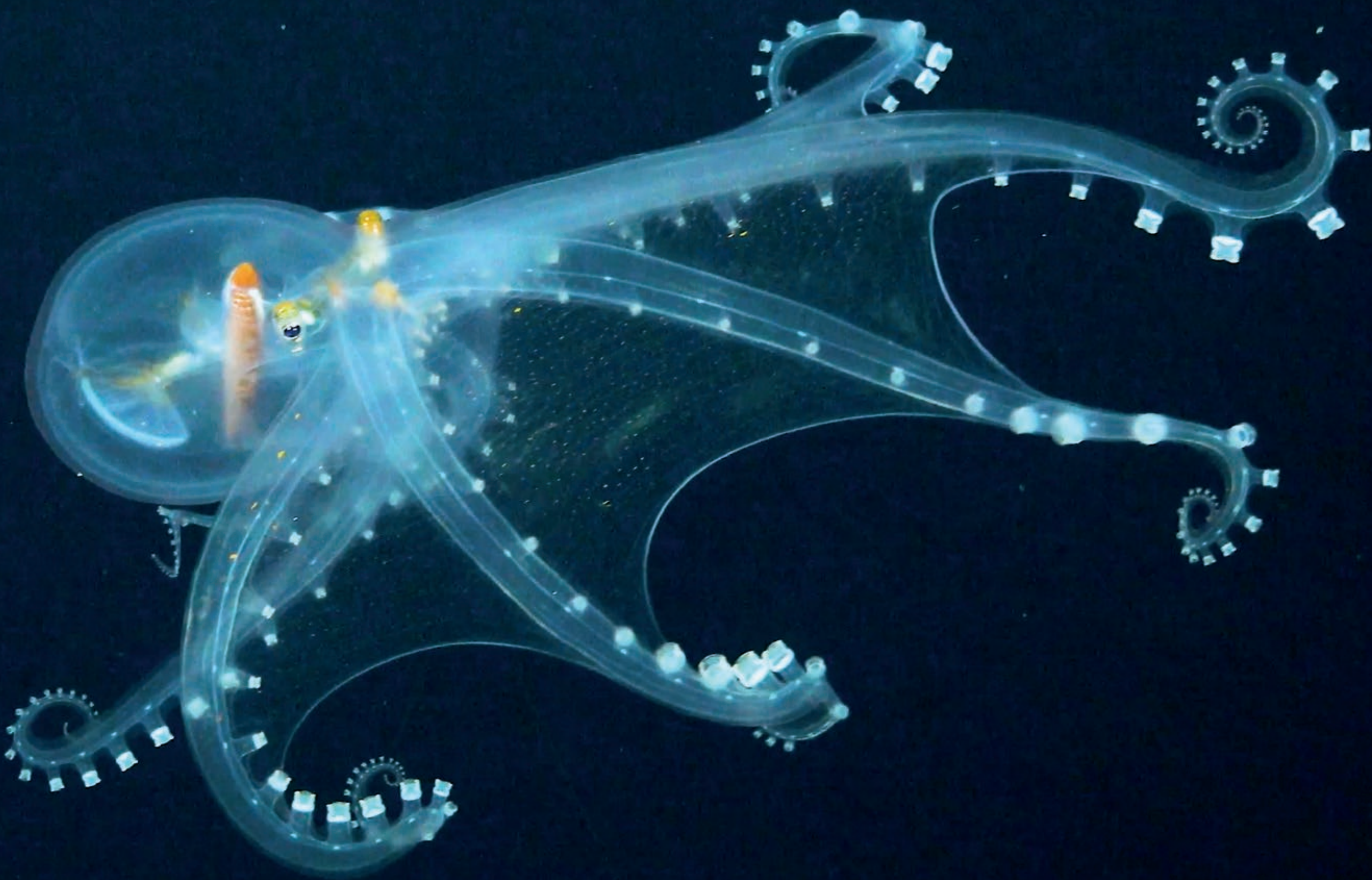
TOWARDS THE ABYSS

How the rush to deep-sea mining threatens people and our planet



A report by the Environmental Justice Foundation

ENVIRONMENTAL JUSTICE FOUNDATION

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The Environmental Justice Foundation Charitable Trust is a UK registered charity that believes we all share a basic human right to a secure natural environment.

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Our work to secure environmental justice aims to protect our global climate, ocean, forests and wildlife and defend basic human rights.

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Vampire squid © The Schmidt Ocean Institute

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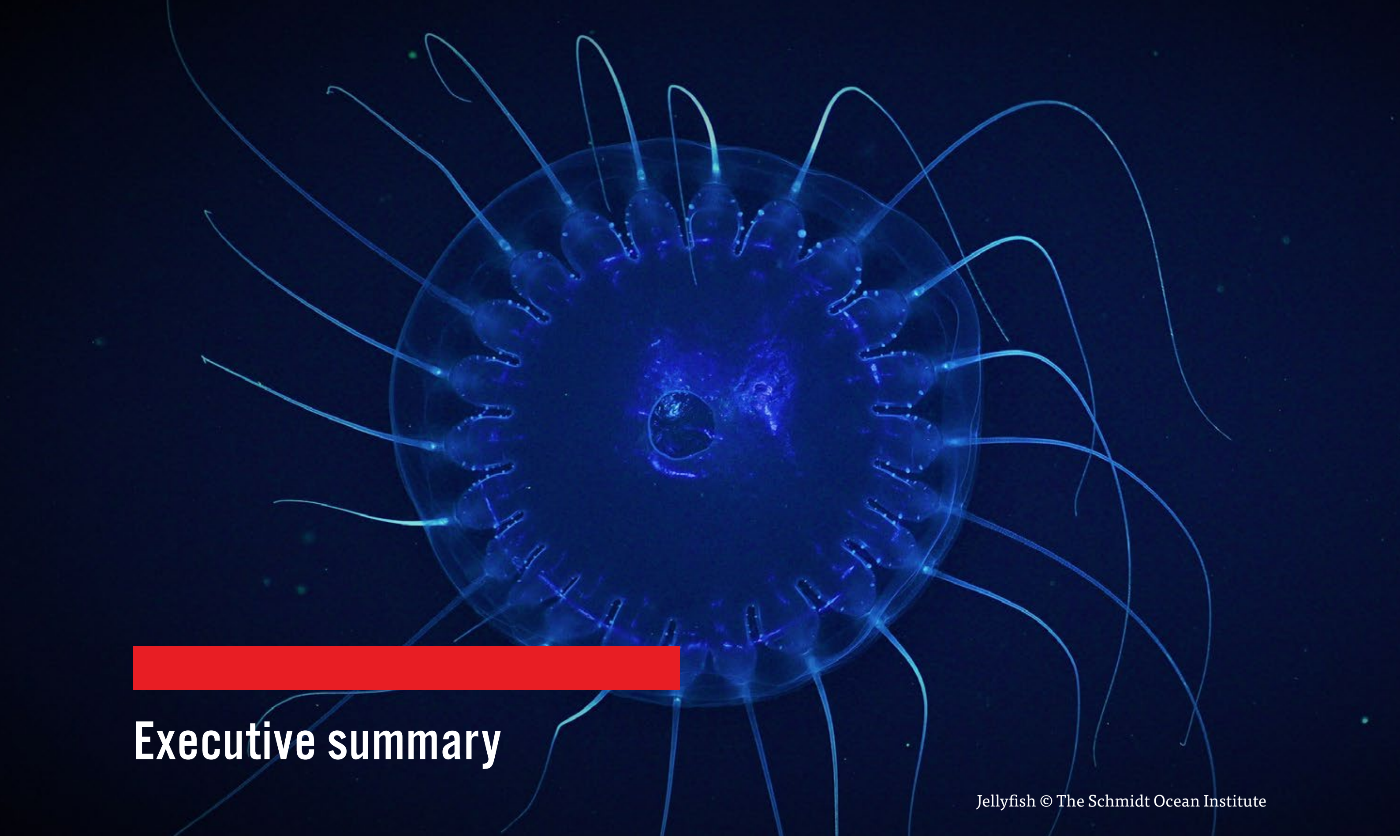
Acronyms and abbreviations

BMJ	Blue Minerals Jamaica
CCZ	Clarion-Clipperton Zone
CEO	Chief Executive Officer
CIIC	Cook Islands Investment Corporation
COP	Conference of the Parties
DEME	Dredging, Environmental and Marine Engineering NV
DSCC	Deep Sea Conservation Coalition
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPC	Economic Planning Commission
ESG	Environmental, Social and Governance
EU	European Union
EV	Electric vehicle
GSR	Global Sea Mineral Resources NV
ISA	International Seabed Authority
IUCN	International Union for the Conservation of Nature
ITLOS	International Tribunal for the Law of the Sea
LFP	Lithium-iron-phosphate
LTC	Legal and Technical Commission
MIT	Massachusetts Institute of Technology
MPA	Marine Protected Area
NGO	Non-governmental organisation
NORI	Nauru Offshore Resources Inc.
NPV	Net present value
OMS	Ocean Mineral Singapore Pte Ltd
RMI	Rocky Mountain Institute
SOAC	Sustainable Opportunities Acquisition Corp
SPAC	Special Purpose Acquisition Company
TMC	The Metals Company
TOML	Tonga Offshore Mining Limited
UKSR	UK Seabed Resources Limited
UNCLOS	UN Convention on the Law of the Sea
WWF	World Wide Fund for Nature



Executive summary

Jellyfish © The Schmidt Ocean Institute

The deep sea remains a pristine ecosystem, largely untouched by human activity. It is enormous in size, covering 65% of the Earth's surface and making up more than 95% of the Earth's biosphere.[1] Its biodiversity is comparable to that of tropical rainforests.[2] The relevance of its ecosystem services cannot be understated: the deep sea is crucial for global climate regulation and forms an important part of oceanic food webs.

Yet, this major pillar of life is threatened by the introduction of deep-sea mining, which could be allowed to start as early as July 2023. This new practice of mineral extraction – which could become the largest mining operation in history[3] – threatens to significantly disturb the delicate environment of the deep sea, with devastating consequences for life on earth.

This endeavour is in pursuit, although major scientific knowledge gaps about the deep sea persist[4] and despite fierce resistance from scientists, businesses, civil society actors, and an increasing number of states. Without thorough scientific knowledge, an adequate risk assessment is impossible, and responsible decision-making which guarantees the integrity of our environment and the ecosystem services it provides cannot be made.

Deep-sea mining has to be stopped.

EJF urges the international community to stop the rush towards any deep-sea mining activity and the international legal framework that is to govern it – the Deep Sea Mining Code.

1. Stop Deep Sea Mining.

All efforts should be made by the international community, in particular governments and corporations, to prevent mining operations in the deep sea. The depths of the ocean contain some of the most biodiverse, undisturbed, and vulnerable ecosystems on the planet. All scientific evidence gathered so far indicates that the consequences will be devastating for the deep-sea ecosystem, with immense risks for the health of the ocean as a whole and the benefits it can provide for people. Moreover, the climate emergency requires a critical examination of the potential impacts of deep-sea mining activities on the carbon cycle.

2. Scale up investment in deep-sea research with a view to protect our ocean and climate.

Critical gaps in our understanding of the deep sea prevent fully informed, science-based decision-making. The international community should support and promote scientific research on the deep-sea environment, with a view to improving our understanding of its functioning, its rich biodiversity and the ecosystem services it provides, including its role in the carbon cycle.

3. Invest in and implement circular economy solutions.

Both governments and industry must stop following the “take, make, waste” economic model, and transition urgently to a circular economy. This should include promoting and implementing large-scale electronics reuse and recycling programmes and the extension of product life cycles, and investing in energy efficiency and public shared transport systems to reduce the need for resource-intensive energy infrastructure. Investment should be upscaled into technological innovation, such as the development of less resource-intensive batteries to support the clean energy transition. The introduction of mandatory obligations for battery recycling and collection, end-of-life requirements, targets for the recovery of metals and extended producer responsibility will further reduce demand for virgin metals and align our needs with planetary boundaries.

4. Reform of the International Seabed Authority (ISA).

There is an urgent need to improve transparency and accountability of decision-making at the ISA – including through access to information and opportunities for meaningful public participation in deliberations of the Legal and Technical Commission (LTC) – and to address potential conflicts of interest through an independent periodic review process. In the absence of a Scientific Committee and in light of the ISA’s clear mandate to protect the marine environment, the composition of the LTC should be reformed to significantly increase expertise in marine biology and conservation. While these reforms can be implemented immediately and will help to address major shortcomings in governance observed to date, there is a need for a broader overhaul of ISA structures and procedures, including the criteria for electing members to the ISA Council and the procedure for approving applications for exploration/exploitation. Until credible, transparent and independent governance structures for managing the deep-sea commons are in place, no democratic legitimate decisions about deep-sea mining can be made in the interests of all humankind.

5. Ensure the protection of deep-sea biodiversity.

In line with Target 3 of the Kunming-Montreal Global Biodiversity Framework, governments must designate at least 30% of the ocean – including national and coastal waters and the high seas – as ecologically representative, fully or highly protected marine areas (MPAs) by 2030, and provide the resources necessary to ensure they are monitored and fully enforced. Critical in achieving this, is the need to rapidly establish a comprehensive system of MPAs in areas beyond national jurisdiction with high standards of protection for marine biodiversity and ecosystems, in the framework of the recently agreed High Seas Treaty.

Soft coral, squat lobster © The Schmidt Ocean Institute

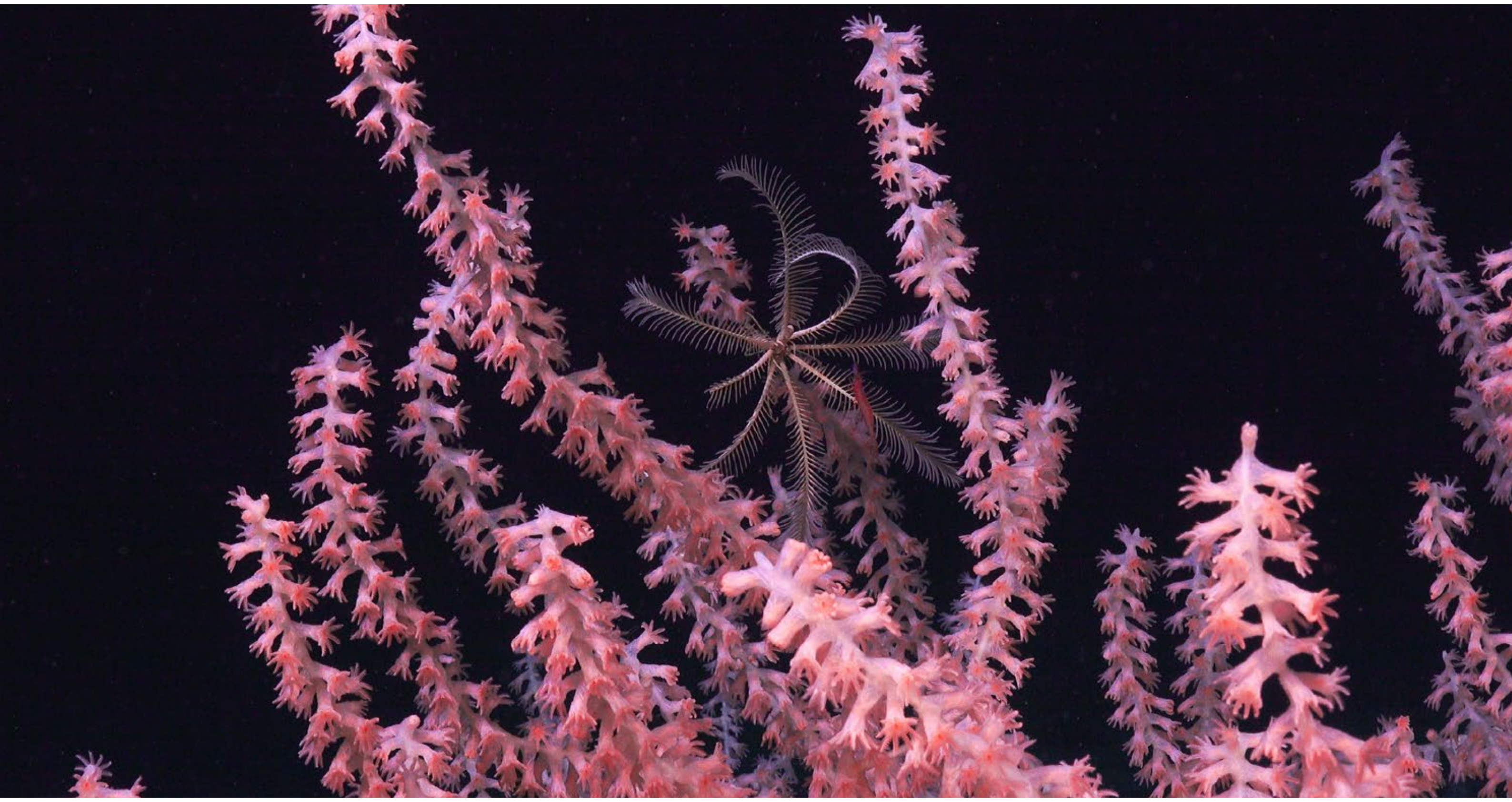
1. Introduction

The deep sea – ocean areas below 200 metres – covers two thirds of the Earth's surface and makes up more than 95% of the Earth's biosphere.[5] It is one of the last unknown frontiers of scientific knowledge on Earth and still a mystery both in its biodiversity and its ecosystem functioning.[6] It harbours an incredibly rich variety of organisms, believed to be comparable to the eclectic biodiversity of tropical rainforests,[7] but it remains almost entirely unknown to science. It is estimated that less than 0.01% of the deep seafloor has been sampled and studied in detail.[8] Scientists discover new species in almost every dive to the ocean floor, the area which is home to around 98% of all marine organisms.[9]

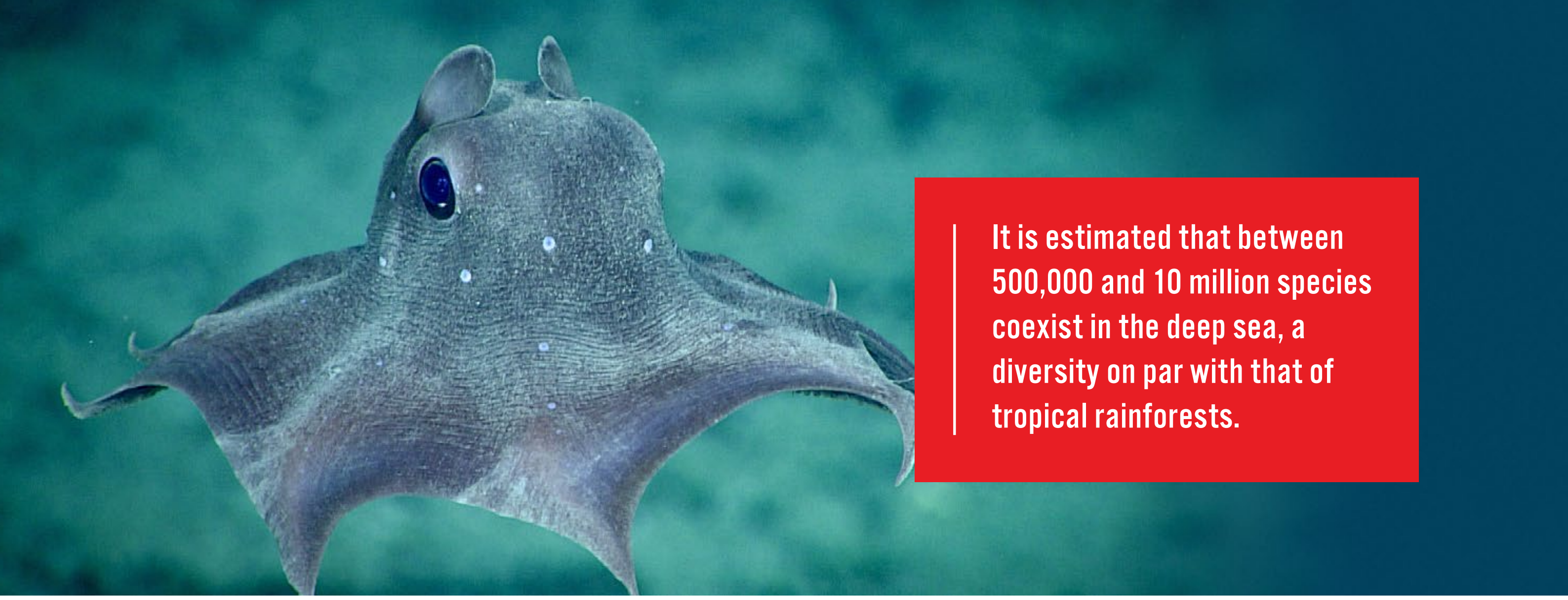
As the deep sea holds vast amounts of valuable metals and minerals like cobalt, copper and manganese which are used in wind turbines and electric car batteries, it has become of great interest to mineral extraction ventures. Proponents of deep-sea mining, essentially a small number of mining companies and governments with vested interests in and connections to the deep-sea mining industry, argue that mining is necessary to successfully manage the energy transition to a low carbon economy.[10]

In July 2021, the Pacific Island nation of Nauru triggered the 'two-year rule', which gave the International Seabed Authority (ISA) two years to finalise rules and regulations for deep-sea mining, potentially paving the way for commercial mining applications to be approved as early as mid-2023. This has prompted widespread global concern about the risk of extensive and irreversible harm to the deep-sea environment, with a growing number of scientists, policy makers, industry and civil society actors calling for a moratorium on deep-sea mining activities.

Against this background, this report aims to examine the threat that deep-sea mining poses to our planet and to the well-being of humanity as a whole, and makes an urgent call to the international community to stop the devastation before it even begins.



Bamboo Coral – Ivan Hurzeler and Deep Search 2019 - BOEM, USGS, NOAA, ROV Jason © Woods Hole Oceanographic Institution



It is estimated that between 500,000 and 10 million species coexist in the deep sea, a diversity on par with that of tropical rainforests.

Dumbo Octopus © NOAA Office of Ocean Exploration and Research, 2019 Southeastern U.S. Deep-sea Exploration.

2. The deep sea

2.1. Deep-sea biodiversity and its role in oceanic food webs

Popular imagination has traditionally seen the deep sea as a barren plain of sand and rock, hostile to life. But the reality is quite different. The deep sea is teeming with life, with a unique, incredibly diverse, and bizarre fauna possessing highly evolved abilities. It is estimated that between 500,000 and 10 million species coexist in the deep sea, a diversity on par with that of tropical rainforests.[11] Samples collected from the deep-sea nodule fields have revealed dozens of previously unknown species.[12] In the Clarion-Clipperton Zone of the Pacific Ocean, where mining is proposed to take place, it is estimated that up to 70–90% of the species collected are new to science.[13]

Because of the harsh conditions of their environment, marine organisms in the deep sea have evolved to exhibit unique traits. Some deep-sea species, for example, have an exceptional longevity. The Greenland shark, the world's longest-lived known vertebrate, can live at least 270 years.[14] Scientists have discovered corals estimated to be over 4,000 years old[15] and sponges up to 11,000 years old - the oldest living animals ever observed on earth.[16] In the absence of sunlight, many deep-sea animals have developed the ability to emit biochemically produced light. Bioluminescence in the deep ocean is essential for communication, reproduction, defence against predators, and prey capture,[17] and is believed to drive the emergence of new species.[18] In parallel, deep-sea fish have developed highly sensitive vision, with the most complex eyes observed in vertebrates.[19] In the freezing-cold depths of the Southern Ocean, scientists have also discovered fish with an antifreeze protein allowing them to survive in temperatures below the freezing point.[20]

Far from being an isolated biome, the deep sea is an important part of the oceanic food web. As photosynthesis is impossible in the absence of sunlight, life in the deep sea is supported almost exclusively by inputs of carbon and energy from the surface waters. 'Marine snow', organic detritus resulting from the breakdown of animal carcasses and faeces, is the primary food source for many deep-sea organisms. Large-scale day-night migrations of plankton and fish between surface waters and deeper parts of the ocean also transport organic matter to the deep sea, sustaining local food webs.[21] Sponges in particular play a key role in the deep-sea food chain: by feeding on dissolved and suspended organic matter, and being themselves an important food source for a range of larger organisms, they provide an entry point for carbon, nutrients, and energy into the food chain.[22]

While photosynthesis cannot occur in the deep sea, the primary production of organic matter can still take place through a process known as chemosynthesis: some bacteria have the ability to fix mineral carbon and convert it into organic carbon, which can be used as a source of energy by other organisms.[23] Tube worms, shrimp, mussels and many other species found aggregated around hydrothermal vents rely on chemosynthetic bacterial symbionts as a food source.[24] As these organisms are in turn consumed by predators, chemosynthetic bacteria support an entire food chain.[25]

Seamounts – where cobalt-rich crusts would be harvested – harbour rich and diverse ecological communities, with corals, sponges, feather stars and an abundance of pelagic fish.[26] They are important aggregation, breeding, foraging and resting areas for emblematic species such as whales, sharks, and turtles,[27]and are used as landmarks by migrating species.[28]

2.2. Deep-sea ecosystems are highly vulnerable to disturbance

In the deepest parts of the ocean, life operates under different rules. Deep-sea organisms live in a highly stable environment, characterised by a very narrow temperature range, constant darkness, low sediment deposition rates, and minimal disturbance and change in environmental conditions over the past tens of thousands of years.[29]

Organisms have evolved over time to adapt to this unique environment, and brusque variations in local conditions, such as sudden illumination or the stirring of sediments, can have very severe consequences for lifeforms that are unequipped to cope with such disturbances.[30]

Many organisms that live attached to hard substrate, such as corals and sponges, are also dependent on mineral structures – including polymetallic nodules, sulphides and cobalt-rich crusts – for habitat. In addition to sustaining the local food chain, these organisms in turn provide essential services for other species. For example, the newly discovered deep-sea octopus known as 'Casper' lays its eggs on sponges that only grow on manganese nodules.[31] Increasing evidence shows that nodules may be an important driver of biodiversity, abundance, and ecosystem functions in the deep sea.[32] Mineral deposits found on the deep seabed have formed over millions of years[33] and cannot be replaced if lost. Associated ecosystems would struggle to recover from the destruction or degradation of this unique habitat.[34]

The ability of deep-sea fauna to recover from disturbances is further limited by their atypical life history traits. Due to the cold temperature, high pressure, and reduced food availability prevalent in their environment, deep-sea organisms tend to have slow growth rates and low fertility,[35] which limits their ability to recover from and makes them acutely vulnerable to disturbances.[36]

2.3. The role of the deep sea in the global carbon cycle

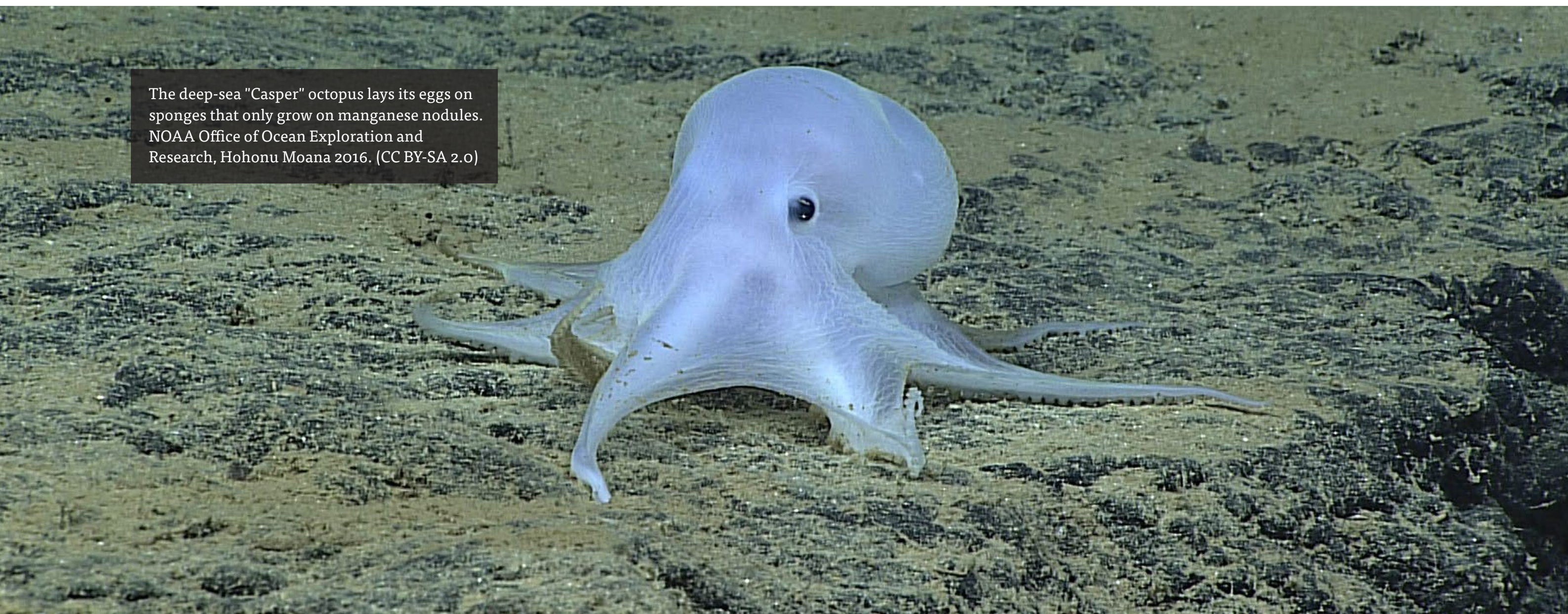
The ocean, and the deep sea in particular, plays a vital role in regulating the global carbon budget and mitigating the effects of global heating.[37] Since the beginning of the industrial era, the ocean has absorbed around 26% of all human-generated CO_2 emissions.[38] While the vast majority of that carbon remains in seawater in dissolved form, a substantial fraction is buried in the seafloor sediments,[39] with deep-sea sediments accounting for 80% of all the carbon stored in marine sediments.[40]

The deep sea is therefore a crucial carbon sink. Carbon reaches the bottom of the ocean through a mechanism known as the biological carbon pump. Organic matter produced at the ocean surface by phytoplankton is actively transported through the food chain into the water column by zooplankton, fish, and other organisms. Carbon-rich detritus generated by dead organisms and faeces sinks to deeper waters, and eventually settles on the seafloor where it is consumed and decomposed by local fauna and bacteria, and buried into the sediment.[41] A single dead whale, for example, can contain up to 33 tonnes of carbon,[42] which can end up stored in the deep sea.

As sediment on the deep seabed accumulates at a rate of 0.3–15 mm every thousand years,[43] the deep sea contains carbon accumulated over tens of thousands, potentially millions of years,[44] and will lock it safely away for generations to come if left undisturbed.

Despite a scientific consensus on the fundamental role of the deep sea in the global carbon cycle,[45] many of the mechanisms involved are in need of further study. Testimony to that are the stunning discoveries that deep-sea research continues to make, such as that of benthic bacteria having the ability to consume CO_2 and convert it to biomass without energy input from sunlight.[46]

Scientists discover new species in almost every dive to the ocean floor, the area which is home to around 98% of all marine organisms.



The deep-sea "Casper" octopus lays its eggs on sponges that only grow on manganese nodules. NOAA Office of Ocean Exploration and Research, Hohonu Moana 2016.

3. Background to deep-sea mining

3.1. Types of deep-sea mining

The deep sea contains large quantities of mineral deposits containing metals such as copper, cobalt, nickel, lithium, silver and rare earth metals. One of the most sought after areas in deep-sea mining exploration – an area of the Pacific known as the Clarion-Clipperton Zone (CCZ) – is estimated to hold six times more cobalt and three times more nickel than all known terrestrial deposits, as well as significant stores of other valuable metals such as manganese and copper.[47] The CCZ covers around 4.5 million square kilometres, roughly the size of the EU.[48]

To date, there are currently 31 mining exploration contracts held by 22 state and private contractors which are searching for three types of mineral resources: polymetallic nodules, polymetallic sulphides and cobalt-rich ferromanganese crusts (**Figure 1**).[49]

To retrieve minerals from the deep sea, mining companies plan to use heavy machinery remotely operated from a surface support vessel. Different extraction methods have been tested for the three main types of minerals.

- **Polymetallic nodules** lying on the seabed are retrieved by collector vehicles driven across the seafloor that use a jet of water to stir up the top layer of sediment and dislodge the nodules. The nodules and surrounding sediments are then sucked up into the collector, where the bulk of the sediment is separated from the nodules. The excess sediment is discharged at the back of the collector while the nodules and remaining sediment are pumped up through a pipe to the surface ship where they will be processed. On board the ship, nodules are separated from the slurry, and the wastewater is then released back into the water column.[50]

- **Polymetallic massive sulphides** are cleaved from mineral formations found near hydrothermal vents. Large volumes of sediments are first removed from the seabed to make space for a mining tool. The machine equipped with a drum cutter carves out blocks of ore, which are then disaggregated into smaller pieces and pumped up to the surface vessel for processing. Wastewater is also pumped back into the water column.[51]

- **Cobalt-rich ferromanganese crusts** covering the summit and slopes of seamounts are technically more difficult to exploit. The extraction process is similar to that used for polymetallic sulphides,[52] with the increased challenge that blocks of ore need to be carved out directly from the seafloor in a rugged environment.

Figure 1: Types of mineral deposit targeted by deep-sea mining

Credit: Ed Harrison / China Dialogue Ocean (CC BY NC ND). Source: Aldred, J. (2019), 'The future of deep seabed mining', *China Dialogue Ocean*. https://chinadialogueocean.net/en/conservation/6682-future-deep-seabed-mining/

Of the three, polymetallic nodules are by far the most sought after (see **Section 3.2.3**).[53] They contain higher quantities of metals such as copper, cobalt, nickel or manganese than any known mineable source on land.[54] Nodule mining is also technologically easier to conduct than crust or sulphide mining, therefore economically more viable.[55] Polymetallic nodules occur mostly in depths below 4,000 metres, lay loosely on the seafloor and can vary in size, ranging from millimetres to a few centimetres in diameter.[56] The CCZ is the main target for polymetallic nodule mining, host to around 21.1 billion tonnes (dry tonnage) of nodules, according to ISA estimates.[57]

Out of the 31 exploration contracts, 19 have been issued for polymetallic nodules. Over the past 20 years, 103 cruises were conducted for exploration of polymetallic nodules, compared to 34 cruises for polymetallic sulphides and 22 cruises for cobalt-rich ferromanganese crusts.[58] In 2022, contractors carried out the first ever commercial mining test for polymetallic nodules, collecting 4,500 tonnes of nodules over an 80 km stretch of the international seabed.[59]

While the majority of exploration contracts for polymetallic nodules are in the CCZ, mining exploration contracts focusing on polymetallic sulphides are located in the Atlantic and Indian Oceans and those targeting cobalt-rich ferromanganese crusts are in the South Atlantic and Western Pacific Ocean[60] (see **Figure 2**).

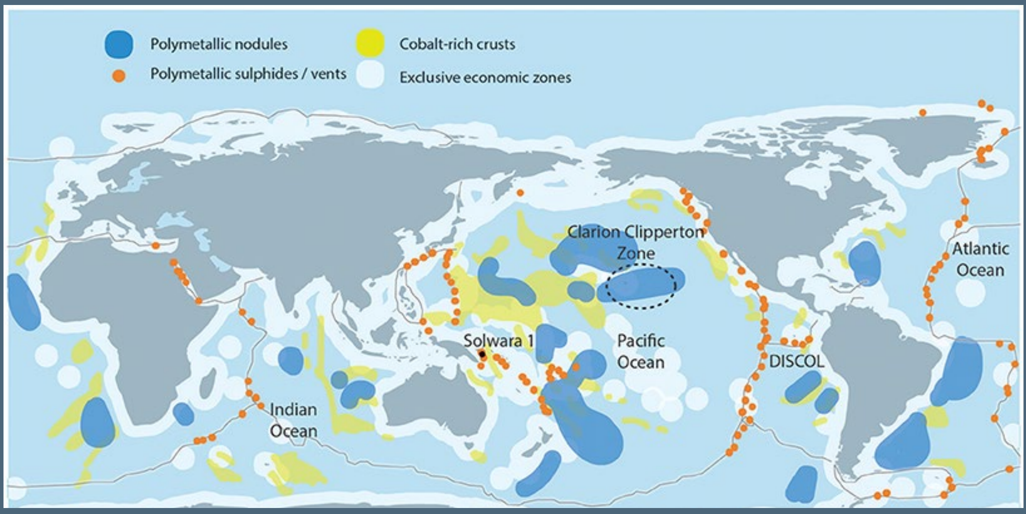
3.2. Governance framework

3.2.1. The International Seabed Authority

The International Seabed Authority (ISA), established under the 1982 United Nations Convention on the Law of the Sea (UNCLOS) and the 1994 Agreement relating to the implementation of Part XI of UNCLOS[61] (Implementation Agreement), is the intergovernmental body of 167 member states and the EU which is responsible for regulating deep-sea mining in the international seabed (the Area). UNCLOS gives the ISA the exclusive mandate to manage seabed minerals in the Area on behalf of "mankind as a whole"[62] (see **Section 5.1**) and the exclusive right to issue exploration and exploitation contracts for minerals in the Area. While the international legal regime is crafted with an operational bias of exploiting resources in the Area, the ISA is also required to ensure the effective protection of the marine environment from harmful effects that may arise from deep-seabed related activities.[63]

The ISA has three principal organs: the Assembly, the Council and the Secretariat. The primary policy-making organ of the ISA is the Assembly in which each member state and the EU are represented[64] following a one state, one vote structure.[65] The Assembly has the

Figure 2: Location of the three types of mineral deposits targeted by deep-sea mining



Source: Miller, K. A., Thompson, K. F., Johnston, P. & Santillo, D. (2018). An Overview of Seabed Mining Including the Current State of Development, Environmental Impacts, and Knowledge Gaps. *Frontiers in Marine Science*, 4, 418, https://doi.org/10.3389/fmars.2017.00418.

The deep sea is teeming with life, with a unique, incredibly diverse, and bizarre fauna possessing highly evolved abilities.
Coral and crabs © The Schmidt Ocean Institute

power to establish, in collaboration with the Council, general policies on all matters within the competence of the ISA.[66] However, in practice, the power dynamics between the organs of the ISA are rather unusual. The Assembly's ability to provide checks and balances as the democratically legitimised body is limited and undermined as it is effectively subordinate to the Council. The Implementation Agreement significantly limited the Assembly's powers by subjecting its decisions to the decision recommended by the Council, where the Council also has competence over the matter.[67] The Assembly is thus the forum where decisions are formally adopted, but many of these decisions must have first been recommended by the Council.[68]

The Council is the executive body of the ISA made up of 36 member states that are elected by the Assembly.[69] The Council enjoys more competencies[70] than the Assembly and can therefore be regarded as the main decision-making organ. However, in practice, it is the advisory subsidiary organ set up by the Council, called the Legal and Technical Commission (LTC),[71] that carries out most of the technical, detailed work of the ISA, with the Council subsequently adopting decisions based on the recommendations of the LTC.

The LTC currently has 41 members[72] and occupies a powerful and central role in the ISA's decision-making (see **Section 7.1**). According to Article 165 UNCLOS, the LTC is responsible for preparing the first drafts of the Mining Code and assessing new applications for exploration and exploitation contracts, two of the most important functions of the ISA. The LTC therefore advises the Council on whether to approve mining projects and is further equipped with broad powers to make recommendations to the Council on environmental protection.[73] If the LTC makes a recommendation to the Council to approve an application (termed 'plan of work') for exploration or exploitation, the plan of work is effectively considered approved after a certain period of time, unless a majority of two thirds of the members of the Council present and voting, including a majority in all four chambers, decide the application should be rejected.[74]

The second subsidiary organ of the Council is the Economic Planning Commission (EPC). The EPC is tasked *inter alia* with supporting and advising the Council on how to minimise adverse effects on the export earnings of economies of developing countries that are key land-based producers of metals, which are likely to be most seriously affected by deep-sea mining in the Area. The EPC is not currently operational. As required in the Implementation Agreement, the LTC has performed the functions of the EPC so far and will continue to do so until such time as the Council decides otherwise, or until the approval of the first plan of work for exploitation.[75]

Finally, UNCLOS also envisages the establishment of the Enterprise[76] – an independent[77] body of the ISA empowered to conduct its own mining activities in the Area.[78] As the Enterprise is not yet operational, its functions are being undertaken by the ISA Secretariat as required by the Implementation Agreement.[79] Originally, the Enterprise was foreseen as a body that would itself conduct deep-sea mining on behalf of humankind (see **Section 5.1**), as possibly the only means by which the vast majority of developing countries would be able to participate in activities in the Area.[80] However, the process to set up the Enterprise has faced a number of challenges, as highlighted by Jaeckel (2020):[81] "*The Implementing Agreement significantly undermined the idea of the Enterprise, not least by eliminating obligatory technology transfers and removing any obligation of States parties to provide funding, leaving the idea of the Enterprise to potentially fail on the basis of insufficient funds.[82] Discussions about setting up the Enterprise have been slow, and its initial functions that were supposed to be performed by the ISA Secretariat have been neglected for some time,[83] causing developing States to repeatedly express dismay at the lack of progress in setting up the Enterprise.*"[84]

3.2.2. The Mining Code

The regulatory framework for commercial mining of the international seabed is still under development. The ISA has already adopted regulations governing prospecting and exploration activities for each of the three types of mineral deposit (the Exploration Regulations), as well as recommendations and guidance for contractors which are periodically updated. The regulations that would govern the commercial scale extraction of minerals from the international seabed – the Exploitation Regulations – as well as associated standards and guidelines are currently under development. The draft Exploitation Regulations[85] have been prepared by the LTC and are under consideration by the Council, which is required to adopt the regulations before commercial mining can begin. Together, the rules, regulations and procedures issued by the ISA to regulate prospecting, exploration and exploitation of marine minerals in the Area are referred to as the Mining Code.[86]

In June 2021, in an unprecedented step, Nauru – the sponsoring state for an Exploration Contract held by NORI, a subsidiary of Canadian corporation, The Metals Company (TMC) (**Box 4**) – triggered a provision of the Implementation Agreement, requesting the Council to elaborate and adopt the necessary rules, regulations and procedures to approve plans of work on deep-seabed exploitation.[87] Once this provision is triggered, the Implementation Agreement states that the Council "*shall*" complete the adoption of such rules, regulations and procedures within two years of such a request[88] – the implications of which are discussed in **Box 1**. The triggering of the so-called 'Two Year Rule' has resulted in a rush within the ISA to finalise the Exploitation Regulations before the end of the period stipulated in Nauru's submission: 9 July 2023.

The eradication of chemosynthetic bacteria near active hydrothermal vents would remove a unique source of biological carbon fixation in the deep ocean.

Hydrothermal vent in the waters of the Pescadero Basin, in the Gulf of California. © The Schmidt Ocean Institute

Box 1: Implications of the Two-Year Rule

Should the Mining Code not have been "*elaborated*" within this two-year period and "*an application for approval of a plan of work for exploitation is pending*", the Implementation Agreement requires the Council to "*nonetheless consider and provisionally approve such plan of work based on the provisions of the Convention and any rules, regulations and procedures that the Council may have adopted provisionally, or on the basis of the norms contained in the Convention and the terms and principles contained in this Annex as well as the principle of non-discrimination among contractors*"[89] (Section 1(15)(c) of the Annex to the Implementation Agreement).

While the ISA Assembly has thus far declined to formally address the implications of the two-year rule,[90] there are several factors that run contrary to an interpretation that would allow for unregulated mining to automatically proceed after the expiration of a two-year period. These are discussed in depth by Singh (2022) and summarised below:[91]

- Section 1(15)(c) specifically refers to "*elaboration*" rather than "*adoption*" of the rules, regulations and procedures. Accordingly, it may be sufficient that such rules are elaborated to consider the Council's obligations under the two-year rule as having been fulfilled. This would provide scope for the Council to agree on key standards and guidelines – which are essential elements of the regulatory framework – prior to considering any application for a plan of work.

- The use of the word "*consider*" in relation to a plan of work indicates that the ISA would have to evaluate and assess the application based on UNCLOS, the Implementation Agreement and any other applicable rules, regulations and procedures that exist.[92] The phrase "*consider and approve*" is used elsewhere in UNCLOS to indicate the need for the relevant ISA organ to exercise judgement when making decisions.[93]

- If the intention of Section 1(15)(c) were to make approvals absolute in the event formalities are met, it would have clarified this explicitly (as is done elsewhere in the Implementation Agreement), which it clearly does not do.[94]

- Section 1(15)(c) allows only for the provisional approval of a plan of work which must not be equated with an exploitation contract. To obtain an exploitation contract, the plan of work would still need to be incorporated into a draft contract, which would then need to be negotiated and concluded with the ISA Secretary-General.[95] In the case of the very first exploration contracts, although plans of work for the exploration of polymetallic nodules were considered and approved in 1997, the exploration contracts were not concluded until after the Exploration Regulations were adopted in 2000. The use of the term "*provisional*" also suggests that the approval can and will be revisited in future – for example, once the Exploitation Regulations have been adopted.[96]

As Singh (2022) concludes, even if an application were to be submitted before the regulatory framework is adopted "*....it appears to be entirely possible for the application to be disapproved by the Council.*" He further notes that if a plan of work is approved in the absence of regulations and grounds exist that do not justify such approval, the ISA could be subjected to compulsory dispute resolution by a member state.[97] Such grounds could include, for example, concerns relating to the protection of the marine environment from the harmful effects of exploitation activities pursuant to the approved plan of work, or with respect to the adequacy of environmental information and measures relating to the plan of work, such as impact assessments or monitoring, as well as the need to apply the precautionary principle.[98]

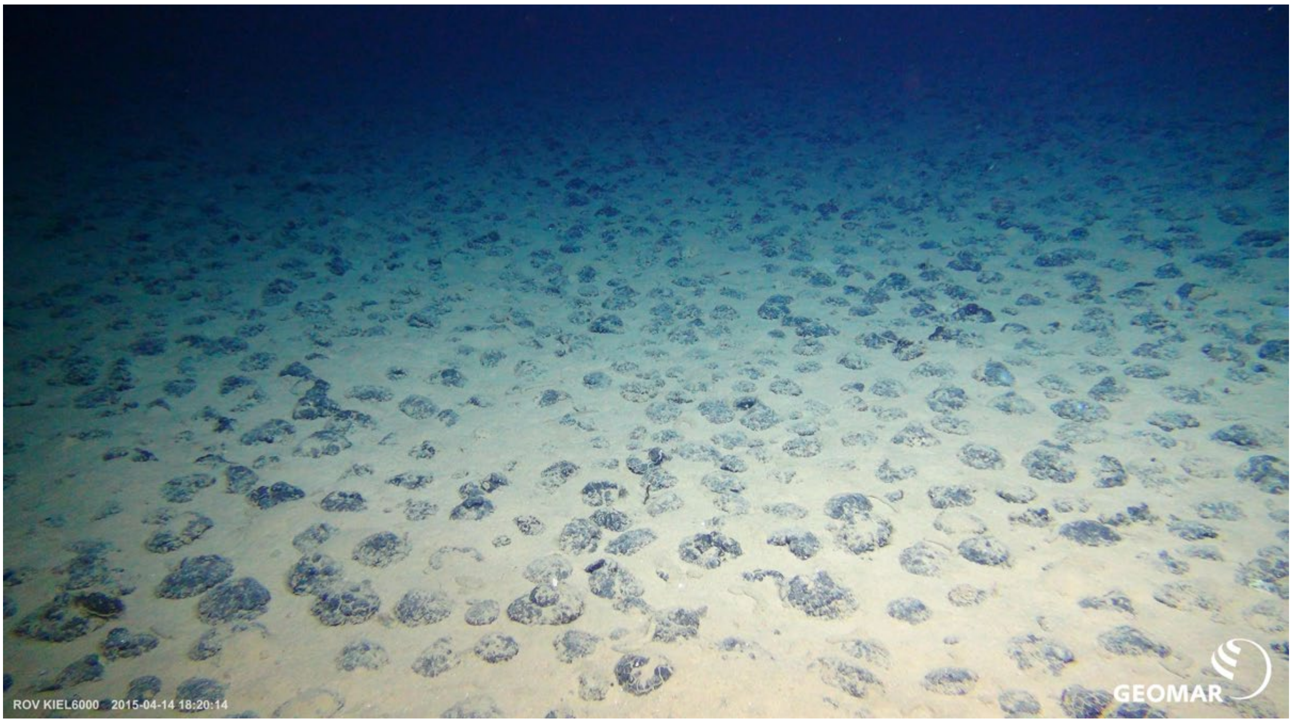
3.2.3. Contracts

Three types of entities are allowed to apply for the right to conduct exploration or exploitation activities in the Area: State parties, State enterprises, or natural or juridical persons which possess the nationality of States parties or are effectively controlled by them.[99] Any state enterprise or any private actor who wants to conduct exploration or exploitation requires a sponsoring state in order to apply for a contract with the ISA.[100]

To date, 31 contracts have been granted to 22 contractors (see **Tables 1 to 3**) – all of them being exploration contracts, since regulations for exploitation are not yet in place. These contracts cover an area of around 1.5 million square kilometres.[101] The ISA issues an exploration contract for an initial period of 15 years. After this time, the Implementation Agreement stipulates that the contracting party must apply for a plan of work for exploitation. Alternatively, the contractor is allowed to apply for an extension of the exploration contract for another five years, provided that they have made efforts to proceed to the exploitation stage, but could not start for reasons beyond the contractor's control, or if the economic circumstances do not justify proceeding to the exploitation stage.[102] The key organ of the ISA at this point is the LTC, which evaluates whether a contractor is eligible for an extension and makes a recommendation to the Council accordingly. Today, seven contracts have been extended for a five-year period, six of them already for the second time.[103]

Applications are deposit-specific.[104] The specific exploration/exploitation area is defined by the applicants themselves, which need to include geographical coordinates of their desired area in the application. An application must cover a total area that is sufficiently large to allow for two mining operations, and divide that area into two parts of equal estimated commercial value.[105] The applicant provides the LTC with verifiable information to substantiate the estimated values of each part. After the LTC evaluates and confirms this information, it makes a recommendation to the Council as to which part should be set aside as a so-called Reserved Area, which is an area designated for mining activities for the Enterprise (see **Section 3.2.1**) or a developing state.[106]

Reserved Areas are a key mechanism for ensuring developing states are able to access deep sea minerals.[107] In practice, however, the allocation of Reserved Areas has raised questions around equity and compliance with UNCLOS (see **Section 5.3.1**). In 2019, almost 1.2 million square kilometres were designated as Reserved Areas, of which 427,495 square kilometres have been allocated to Tonga, Nauru, Kiribati, Singapore, the Cook Islands, and the People's Republic of China[108] for exploration activities relating to polymetallic nodules (**Table 1**).



A single deep-sea nodule mining operation is projected to effectively strip mine around 400 km2 of seabed every year, an area half the size of New York City. ROV KIEL 6000, GEOMAR (CC BY 4.0)

Table 1: Approved exploration contracts for polymetallic nodules
(based on data from ISA (undated), 'Minerals: Polymetallic Nodules', accessed 27.01.2023)

In addition to the contractor that holds the contract, the overseas entity with a significant interest in or effective control of the contractor/contract is also specified in the Table below. The overseas entity is often not specified in published information on applications to the ISA for approval of plans of work, but has been identified based on publicly available data from, among others, credit check websites, company websites and corporate filings, and corroborated with the findings of previous investigations.[109]

	Contractor	Type of entity	Entity with a significant interest or effective control (location of HQ/country of registration)	Arrangement between contractor and entity with significant interest or effective control	State entity or sponsoring state	No. of contracts	Exploration area (sq km)	Reserved area (sq km)
1	Interoceanmetal Joint Organization	State	N/A	N/A	Bulgaria, Cuba, Czech Republic, Poland, Russian Federation, Slovakia	1	75,000	-
2	JSC Yuzhmorgeologiya	State	RosGeo (Russia)[1]	N/A	Russian Federation	1	Not public	-
3	Government of the Republic of Korea	State	N/A	N/A	Korea	1	75,000	-
4	China Ocean Mineral Resources Research and Development Association	State	N/A	N/A	China	1	75,000	-
5	Deep Ocean Resources Development Co. Ltd.	State	Japan Oil, Gas and Metals National Corporation (Japan)[2]	Majority shareholding	Japan	1	75,000	-
6	Institut Français de Recherche pour l'Exploitation de la Mer	State	N/A	N/A	France	1	75,000	-
7	Government of India	State	N/A	N/A	India	1	75,000	-
8	Federal Institute for Geosciences and Natural Resources of Germany	State	N/A	N/A	Germany	1	77,230	-
9	Nauru Ocean Resources Inc.	Private	TMC (Canada)[3]	Subsidiary	Nauru	1	74,830	74,830
10	Tonga Offshore Mining Limited	Private	TMC (Canada)[4]	Subsidiary	Tonga	1	74,713	74,713
11	Global Sea Mineral Resources NV	Private	DEME (Belgium)[5]	Subsidiary	Belgium	1	74,990	-
12	UK Seabed Resources Ltd.	Private	Lockheed Martin (US)[6]	Subsidiary (of Lockheed Martin UK)	United Kingdom of Great Britain and Northern Ireland	2	133,539	-
13	Marawa Research and Exploration Ltd.	Private	TMC (Canada)[7]	Partnership	Kiribati	1	74,990	74,990
14	Ocean Mineral Singapore Pte Ltd.	Private	Keppel Corporation (Singapore)[8]	Subsidiary	Singapore	1	58,280	58,280
15	Cook Islands Investment Corporation	Private	DEME (Belgium)[9]	Joint venture	Cook Islands	1	73,177.64	71,937
16	China Minmetals Corporation	State	N/A	N/A	China	1	72,745	72,745
17	Beijing Pioneer Hi-Tech Development Corporation	State	China Ocean Mineral Resources Research and Development Association (China)[10]	Subsidiary	China	1	74,052	-
18	Blue Minerals Jamaica Ltd	Private	Allseas Group[11]	Subsidiary	Jamaica	1	Not public	
					Total	**19**	**1,238,546.64**	**427,495**

Notes to table:

[1] RosGeo (undated), 'Transit area operations', accessed 08.02.2023, https://rusgeology.ru/en/services/geologorazvedka-uvs/morskaya-geologorazvedka/seysmorazvedka-v-tranzitnoy-zone/.

[2] Deep Ocean Resources Development (undated), 'Company Profile', accessed 08.02.2023, https://www.dord.co.jp/english/about/index.html.

[3] The Metal Company (undated), 'NORI-D Project – Nauru Ocean Resources Inc.', https://metals.co/nori/; The Metal Company (2021). *Prospectus filed with the US Security and Exchange Commission pursuant to Rule 424(b)(3)*. 22 October 2021. https://www.sec.gov/Archives/edgar/data/1798562/000121390021054189/f424b31021_tmcinc.htm; Sustainable Opportunities Acquisition Corp (2021). *Form S-4 filing with Securities and Exchange Commission*. 5 August 2021. https://www.sec.gov/Archives/edgar/data/1798562/000121390021040480/fs42021a5_sustainableopp.htm

[4] The Metal Company (2021). *Prospectus filed with the US Security and Exchange Commission pursuant to Rule 424(b)(3)*. 22 October 2021. https://www.sec.gov/Archives/edgar/data/1798562/000121390021054189/f424b31021_tmcinc.htm; Sustainable Opportunities Acquisition Corp (2021). *Form S-4 filing with Securities and Exchange Commission*. 5 August 2021. https://www.sec.gov/Archives/edgar/data/1798562/000121390021040480/fs42021a5_sustainableopp.htm.

[5] GSR (undated), 'Harnessing ocean minerals', accessed 07.02.2023, https://deme-gsr.com/.

[6] Lockheed Martin (undated), 'UK Seabed Resources', accessed 08.02.2023, https://www.lockheedmartin.com/en-gb/products/uk-seabed-resources.html; UK Seabed Resources Ltd. (2022). *Annual Report and Financial Statements for the year ended 31 December 2021*. 4 October 2022. https://find-and-update.company-information.service.gov.uk/company/08058443/filing-history. The latter document identifies Lockheed Martin as the "ultimate parent undertaking and controlling party" of UKSR (at p.16).

[7] Sustainable Opportunities Acquisition Corp (2021). *Form S-4 filing with Securities and Exchange Commission*. 5 August 2021. https://www.sec.gov/Archives/edgar/data/1798562/000121390021040480/fs42021a5_sustainableopp.htm.

[8] Anon. (2015), 'Keppel Corp unit signs seabed exploration contract', *Reuters*, 16 June 2015, accessed 07.02.2023, https://www.reuters.com/article/keppel-corp-contract-seabed-idUKL3N0Z23IL20150616. Ocean Mineral Singapore Pte Ltd (OMS), Keppel's subsidiary and holder of the contract, reportedly has a partnership arrangement with UKSR/Lockheed Martin. UKSR holds a 19.9% share in a joint venture with OMS according to UKSR's Annual Report and Financial Statements for the year ended 31 December 2021.

[9] CIIC Seabed Resources Limited, 20/21 Application for a seabed minerals exploration licence, https://static1.squarespace.com/static/5cca30fab2cf793ec6d94096/t/6186fa13f5624d55b5d3182d/1636235798565/CIICSR_Public+summary+of+application.pdf. The document notes that CIIC Seabed Resources (CIIC-SR) is a joint venture between Cook Islands Investment Corporation (CIIC – a statutory Corporation of the Cook Islands Government) and Global Sea Mineral Resources Cook Islands (GSR-CI), owned by Global Sea Mineral Resources NV (GSR), part of the DEMEGroup, located in Belgium.

[10] Shuidi (undated), 'Beijing Pioneer High-Tech Development Co. Ltd – company information', accessed 07.02.2023, https://shuidi.cn/company-177f74884e979e7d1f18c188e05383c7.html?from_search=1&showIntro1=1&tag=doc.

[11] Blue Minerals Jamaica Ltd (2022). *Annual Return for Companies with Shares for the period ending 12 December 2020*, obtained by EJF from the Companies Office of Jamaica; Federal Commercial Registry Office (ZEFIX) (undated), 'Blue Minerals Switzerland SA', accessed 31.01.2023, https://www.zefix.ch/en/search/entity/list/firm/1438678. Blue Minerals Jamaica Ltd is a subsidiary of Blue Minerals Switzerland SA, a holding company connected to the Allseas Group and directed by the same board of directors.

Table 2: Exploration contracts for polymetallic sulphides

(based on data from ISA (undated), 'Minerals: Polymetallic Sulphides', accessed 27.01.2023)

	Contractor	Type of entity	Entity	No. of contracts	Exploration area (sq km)
1	Government of the Republic of Korea	State	Korea	**1**	10,000
2	China Ocean Mineral Resources Research and Development Association	State	China	1	10,000
3	Institut Français de Recherche pour l'Exploitation de la Mer	State	France	1	10,000
4	Government of India	State	India	1	10,000
5	Federal Institute for Geosciences and Natural Resources of Germany	State	Germany	1	10,000
6	Government of the Russian Federation / Ministry of Natural Resources and Environment of the Russian Federation	State	Russian Federation	1	Not public
7	Government of the Republic of Poland	State	Poland	1	10,000
			Total	**7**	**60,000**

Table 3: Exploration contracts for cobalt-rich ferromanganese crusts
(based on data from ISA (undated), 'Minerals: Cobalt-rich Ferromanganese Crusts', accessed 27.01.2023)

	Contractor	Type of entity	Entity	No. of contracts	Exploration area (sq km)
1	Government of the Republic of Korea	State	Korea	1	3,000
2	China Ocean Mineral Resources Research and Development Association	State	China	1	3,000
3	Government of the Russian Federation / Ministry of Natural Resources and Environment of the Russian Federation	State	Russian Federation	1	Not public
4	Japan Oil, Gas and Metals National Corporation (JOGMEC)	State	Japan	1	3,000
5	Companhia De Pesquisa de Recursos Minerais	State	Brazil	1	3,000
			Total	**5**	**12,000**

Sperm whales. Credit: Amanda Cotton / Ocean Image Bank

4. Environmental impacts of deep-sea mining

Despite efforts by the mining industry to present deep-sea mining as a clean alternative to land-based mining with minimal environmental footprint,[110] independent reviews of the available scientific evidence commissioned by governments[111] and conducted by civil society organisations[112] are in agreement that deep-sea mining will cause potentially severe adverse impacts to the marine environment, its biodiversity, and ecosystems.

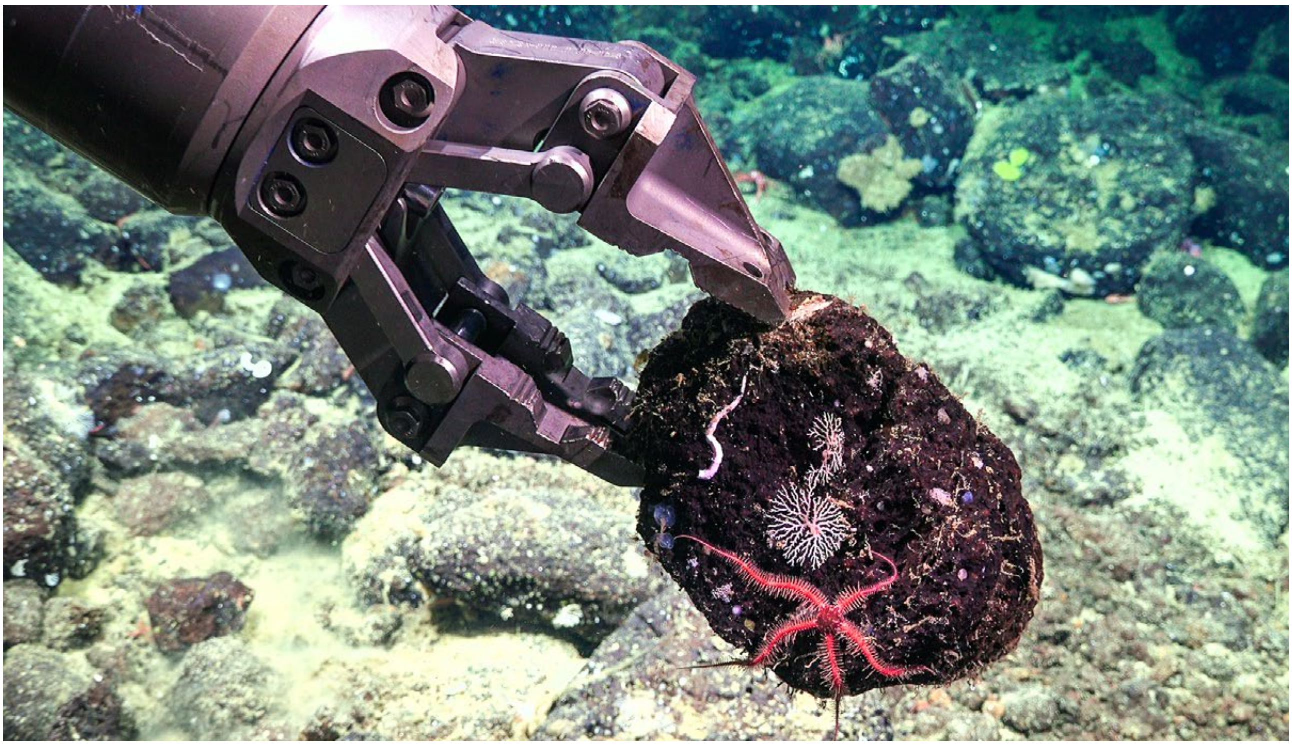
> ***"[Deep-sea mining] may be one of the more damaging industrial impacts on the deep oceans, because of the potential for the broad spatial scale of the impacts. Impacts of nodule mining will be particularly extensive (likely 100s km² per operation)....Long-term (>centuries) and broad-scale (>1,000km²) impacts...are likely."***

UK Deep Sea Mining Evidence Review[113]

Deep-sea mining could erase the oldest living organisms on the planet.

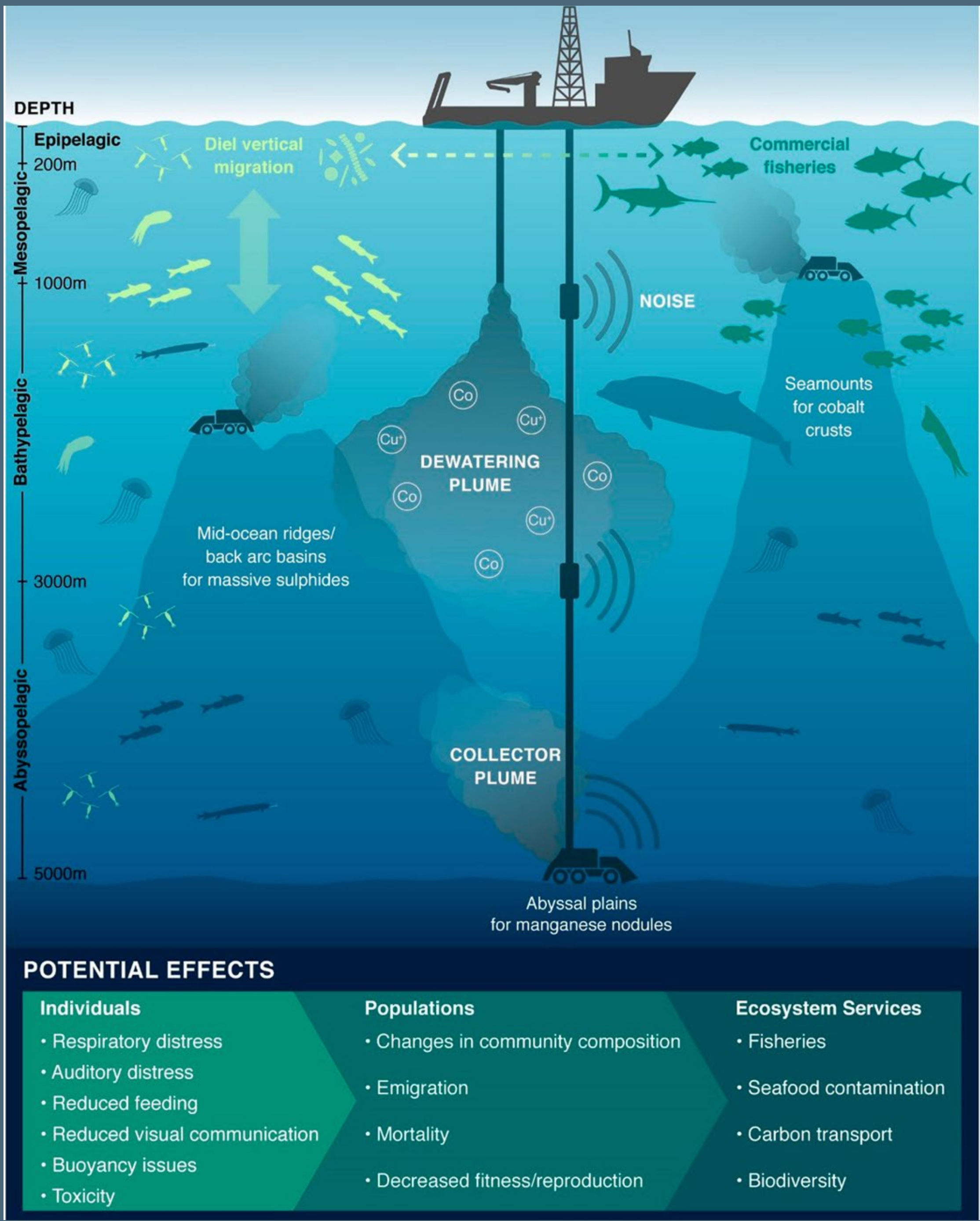
To be financially viable, a single deep-sea nodule mining operation is projected to effectively strip mine around 400 km² of seabed every year,[114] an area half the size of New York City, stirring up 10 million tonnes of seafloor sediment[115] and discharging an additional 180,000 tonnes of processed sediment back into the sea.[116] Suspended sediments can travel hundreds of kilometres with ocean currents,[117] potentially affecting organisms across vast swaths of the ocean. Impacts from noise pollution will also be felt within a 500-km radius.[118] If all exploration concessions granted to date were exploited over a 20-year period, the total environmental footprint could range from 500,000[119] to several million square kilometres,[120] equivalent to anywhere between 10 and 60% of the Amazon rainforest.

Deep-sea mining will cause significant disturbances to the marine environment, including direct damage to the benthic fauna, habitat destruction, pollution from sediment plumes and wastewater discharge, and noise and light pollution across the water column.[121] These disturbances will result in biodiversity loss, disrupt marine ecosystem functions and food webs, and potentially impact fisheries and disrupt the oceanic carbon cycle.



Hard substrate and structures formed by mineral deposits over millions of years provide critical habitat for marine life.
Brittle star on rock © The Schmidt Ocean Institute

Figure 3: Deep-sea mining processes and impacts.



Source: Drazen, J. C. et al (2020). Midwater ecosystems must be considered when evaluating environmental risks of deep-sea mining.[122]

4.1. Biodiversity loss

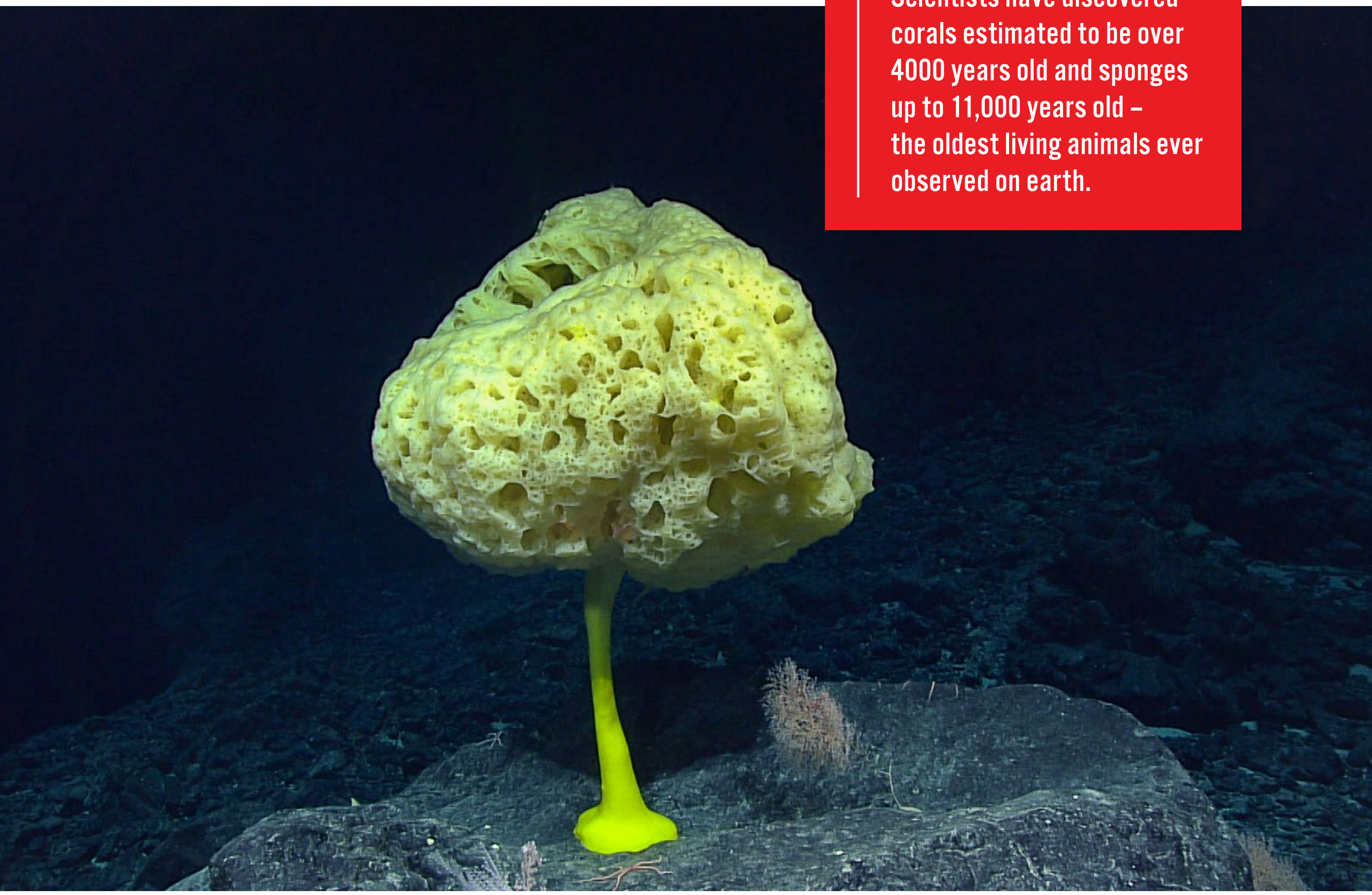
If mining is allowed to proceed in the deep sea, biodiversity loss will be inevitable.[123] Deep-seabed communities form isolated pockets of life, with a high proportion of species found nowhere else on earth,[124] and even species observed only on polymetallic nodules.[125] If these communities are decimated by mining, unique species may become extinct, causing irreparable biodiversity loss.[126] This is all the more concerning as proposals to offset biodiversity loss from deep-sea mining are believed to be either impossible or scientifically meaningless.[127]

> ***"Loss of biodiversity in the deep sea is inevitable and may be considered to be "forever" on human time scales."***
>
> Niner et al. (2018)[128]

4.1.1. Physical disturbance

Marine organisms that live on the seafloor of mined areas, like sponges, corals, sea cucumbers, and sea lilies, will suffer lethal damage. Organisms that live attached to collected minerals or lie in the way of collector vehicles will be crushed and torn out, while those in the vicinity or in the wake of collectors will be buried under the stirred sediments or smothered by resuspended particles.[129] Many organisms are poorly adapted to cope with sudden sediment redeposition in an environment where sediment deposition rates are normally very low.[130] Suspension feeders, for example, will suffocate as suspended particles clog their feeding and respiratory apparatus.[131] Small fish and free-floating organisms may also be caught by the hydraulic suction system of collectors.[132]

Scientists have discovered corals estimated to be over 4000 years old and sponges up to 11,000 years old – the oldest living animals ever observed on earth.



Bolosoma sp., glass sponge, NOAA Office of Ocean Exploration and Research, Deep-Sea Symphony: Exploring the Musicians Seamounts (CC BY-SA 2.0)

4.1.2. Habitat destruction

The immediate damage caused by mining extractors will be compounded by the long-term effects of habitat destruction. The hard substrate and structures formed by mineral deposits over millions of years[133] provide critical habitat for marine life. Removing the substrate makes it impossible for larvae of marine organisms to settle and recolonise damaged sites.[134] Experiments studying the long-term impacts of deep-sea mining show that many bottom-dwelling organisms are found at abnormally low abundance in formerly mined sites. For example, seven years after disturbance, organisms that live attached to hard substrate had nearly disappeared from mined areas,[135] and after 26 years, suspension feeders were still at 40% of pre-disturbance levels.[136] Organisms that live on or in the soft sediment also struggle to recover when the sediment is disturbed, including deposit feeders such as sea cucumbers,[137] smaller organisms like worms and crustaceans,[138] and microbial communities, which play a key role in sediment biogeochemistry.[139]

Disturbed seabed communities could take several decades or centuries to recover, and some may never recover at all.[140] Population recovery is particularly difficult for deep-sea species, which are often characterised by slow growth rates and low fecundity.[141] For instance, the Greenland shark, the world's longest-lived vertebrate, reaches sexual maturity at around 150 years.[142] If individuals are killed or their habitat is destroyed, the species may never be able to recover.

4.1.3. Large-scale impact of sediment plumes and toxic compounds

The impact of deep-sea mining will be felt way beyond mined sites. Sediment plumes resulting from wastewater discharge in the midst of the water column can drift with ocean currents over vast distances, from 100 km for coarse sediment to over 1,000 km for finer particles, potentially affecting an area of several million square kilometres.[143]

While the risk of burial and smothering decreases as sediment dilution increases moving away from the discharge point, the finest particles can remain in suspension for years[144] and still cause significant damage to sensitive filter feeders like mussels.[145] Moreover, toxic heavy metals and other substances contained in the plume can cause severe damage to marine fauna, even at low concentration.[146] For example, corals exposed to sediment plumes can die from copper intoxication after only 13 to 27 days.[147] Sub-lethal doses of toxic metals can also affect the behaviour of marine organisms.[148]

4.1.4. Noise and light pollution

Noise and light pollution from deep-sea mining will affect the behaviour of many marine organisms, putting additional pressure on already threatened wildlife. For example, noise from underwater mechanical vibrations will disrupt marine mammals' ability to communicate and locate prey and predators, disturbing endangered migratory whales.[149] Noise pollution may also disorientate marine larvae, which rely on phonic cues for settlement.[150]

Light is also a source of disturbance. In the permanent darkness of the deep sea, where many organisms rely on bioluminescence to attract prey, defend themselves and communicate,[151] bright illumination will mask bioluminescence, blinding animals and disrupting essential behaviour.[152] Light from the surface support vessel will also attract fish, disrupting day-night migration patterns, schooling and foraging behaviour, as well as reproduction.[153]

Young male humpback whales, Moorea, French Polynesia.
Credit: Ron Watkins / Ocean Image Bank

Noise from underwater mechanical vibrations will disrupt marine mammals' ability to communicate and locate prey and predators.

4.2. Disruption of ecosystem functions

Deep-sea mining risks having a profound and long-lasting impact on marine ecosystems, transforming ecological communities, disrupting food webs, and ultimately impairing critical functions performed by deep-sea ecosystems for all marine life.

Experiments show that as the more vulnerable organisms are eradicated from mined areas, the faunal composition of deep-sea communities changes to exhibit lower species richness and diversity.[154] These changes risk triggering substantial community shifts that can persist over geological timescales.[155]

The removal of nodules is predicted to have knock-on effects on the entire food chain, reducing species richness by 20% and the number of connections in the food web by up to 30%.[156] Losing species will cause general reductions in ecosystem functions, with lower biomass production, lower biomass consumption in the food chain, and lower nutrient, oxygen, and water exchange.[157] For example, mining of polymetallic sulphides near active hydrothermal vents risks eradicating carbon-fixing bacteria that are the main source of organic compounds for much of the local marine life, promote the settlement of other organisms by attracting larvae, and regulate local biochemical conditions,[158] triggering the collapse of an entire ecosystem as a result.

The disruption of ecosystem functions would in turn have negative impacts on the services marine ecosystems provide for people, with potential repercussions on the populations and recovery potential of fisheries, and coastal water quality.[159]

4.3. Impact on fisheries

The combined effects of food web disruption, pollution from sediment plumes in the water column, and light pollution caused by deep-sea mining are predicted to impact fisheries, with a potential reduction of fish populations.[160]

The destruction of deep-sea habitats, in particular seamounts which attract large aggregations of fish,[161] risk depleting prey populations for commercially relevant fish species like tuna and snappers.[162] Likewise, increased turbidity in surface waters due to sediment plumes would impact photosynthetic production by phytoplankton,[163] reducing the volume of biomass circulating in the food chain and ultimately impacting fish populations. Toxic compounds contained in sediment plumes can also travel vertically to reach surface waters,[164] where they risk intoxicating fish larvae.[165] The effect of toxic substances in large predator fish are further compounded by bioaccumulation,[166] as toxins accumulate through the food chain.[167] Finally, light pollution from collector vehicles and surface vessels may disrupt fish day-night migration, reproduction, and foraging patterns.[168]

Negative impacts on fisheries would entail potentially severe economic repercussions not only for small island nations like Samoa and Kiribati, but also for large maritime powers like France, which all derive between 10 and 40% of their catch from fisheries that overlap with deep-sea mining areas.[169]

Deep-sea mining is predicted to negatively impact fisheries, causing potential declines in fish populations.

Yellowfin Tuna.
Credit: Ellen Cuylaerts / Ocean Image Bank

In the absence of a solid baseline, environmental impact assessments are unreliable and are likely to underestimate the extent and magnitude of environmental impacts. A freshly sampled octocoral is processed in the lab onboard a research vessel. © The Schmidt Ocean Institute

4.4. Disruption of the carbon cycle

Deep-sea mining is projected to stir up millions of tonnes of seafloor sediments every year,[170] effectively reinjecting carbon that had been accumulating over millions of years[171] into the oceanic carbon cycle. An unknown proportion of that carbon can be remineralised due principally to microbial activity, increasing the amount of CO_2 dissolved in seawater.[172] This in turn would accelerate ocean acidification, with negative effects on growth and reproduction for a wide range of marine organisms.[173] Should that CO_2 reach surface waters and be released into the atmosphere, it would also further compound global heating.

The destruction of deep-sea habitats by mining will also disrupt key carbon sequestration mechanisms. For example, the eradication of chemosynthetic bacteria near active hydrothermal vents will remove a unique source of biological carbon fixation in the deep ocean.[174] Damage caused to seamounts for cobalt-rich crust mining will also have an impact on the abundance of fish, which play a key role in transporting carbon from surface waters to the deeper ocean.[175]

Disturbance to seafloor sediments by collector vehicles will also have long-term impacts on carbon flows in benthic communities. 26 years after mining, the amount of carbon stored in marine fauna and the amount of carbon going through the food chain remain just over half the values observed in undisturbed areas.[176]

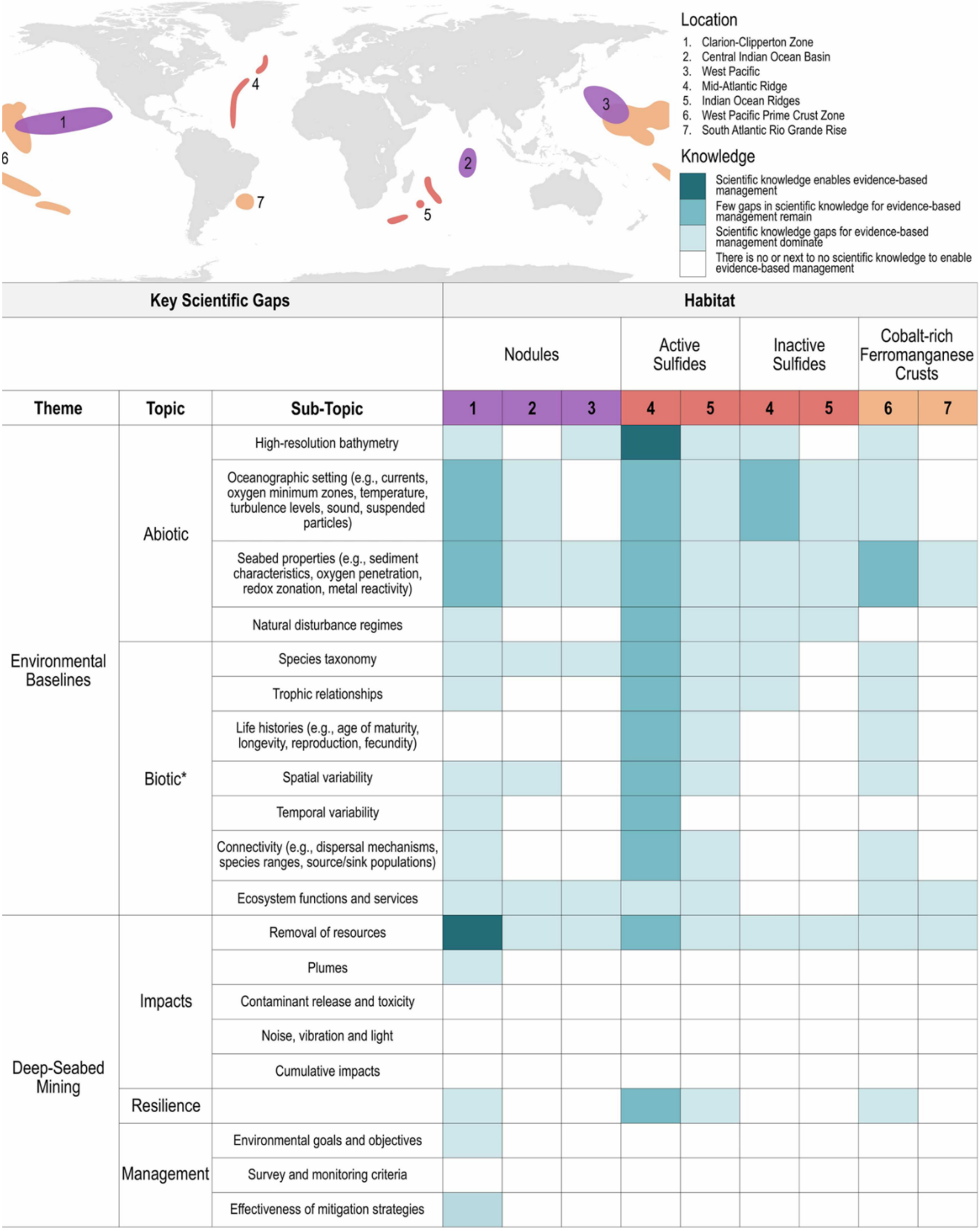
The impacts of deep-sea mining on the global carbon budget remain poorly understood but could be severe, in effect negating the effect of millions of years of ecological and biochemical processes in just a few years.

4.5 Critical knowledge gaps

While the available scientific evidence establishes a clear risk of serious adverse environmental impacts, the extent and magnitude of the damage deep-sea mining would cause to the marine environment remain unknown.

The severity of the environmental impact of deep-sea mining cannot be fully evaluated without a more robust understanding of deep-sea ecosystems, their biodiversity, and their ecological processes.[177] Critical knowledge gaps remain that prevent fully informed, science-based decision-making (**Figure 4**). In the absence of a solid baseline, environmental impact assessments are unreliable[178] and are likely to underestimate the extent and magnitude of environmental impacts.

Figure 4: **Current level of scientific knowledge in relation to evidence-based environmental management of deep-seabed mining in regions where exploration contracts have been granted by the ISA.**[179]



Note: *denotes benthic and pelagic habitats.

Reproduced from Amon, D. J., Gollner, S., Morato, T., Smith, C. R., Chen, C., Christiansen, S. et al. (2022). Assessment of scientific gaps related to the effective environmental management of deep-seabed mining. *Marine Policy*, 138, 105006, https://doi.org/10.1016/j.marpol.2022.105006. Compiled from a synthesis of the peer-reviewed literature and expert opinion, including both target and non-target areas within each region.

5. Implications for equity and justice

The prospect of mining the international seabed has potentially serious equity implications, both across humanity today and for future generations. A key area of doubt is whether mining activities would be of benefit to humankind as a whole, as required under UNCLOS, bearing in mind that UNCLOS does not allow any trade-offs between the imperatives of environmental protection and of furthering the common heritage of humankind (**Section 6**). The potential benefits of mining have not been reliably quantified, and there are also serious concerns surrounding the equitable distribution of costs and benefits of mining activities: who stands to benefit beyond a few powerful corporations and their shareholders, and who will shoulder the burden? The issues at stake are of far-reaching global significance, with implications for human well-being and, potentially, survival. Yet, decisions are being taken behind closed doors, by a group of individuals unfairly prejudiced in favour of mining interests and unrepresentative of the international community (**Section 7**), and without the meaningful involvement of stakeholders that stand to lose the most if mining activities are to proceed.

Taking fish to market. Solomon Islands. Credit: Rob Maccoll / AusAID. (CC BY 2.0)

5.1. The international seabed and its resources – our common heritage

The international seabed (the "Area") and its resources are defined, under UNCLOS, as the "common heritage of [hu]mankind".[180] Activities in the Area are to be carried out for the benefit of humankind as a whole, taking into particular consideration the interests and needs of developing states.[181] The ISA is expressly obliged, under UNCLOS, to act on behalf of humankind,[182] whilst UNCLOS also calls for the equitable sharing of economic and other financial benefits of mining on a non-discriminatory basis through appropriate mechanisms.[183]

The common heritage principle encompasses elements including non-appropriation, the sharing of benefits and preservation for future generations.[184] At its core is a notion of equity – ensuring no nation is left behind and that developing states are able to share in the benefits from activities relating to the 'global commons' of the international seabed.

The common heritage principle is enshrined in the Mining Code – in both the ISA Exploration Regulations and the draft Exploitation Regulations currently under development. The latter requires the ISA, when determining whether or not to approve an application for an exploitation contract, to have regard to: "the manner in which the proposed Plan of Work contributes to realizing benefits for mankind as a whole."[185] Thus, when considering a contract for mining activities, the ISA is effectively under an obligation to consider the value of the individual mining operation to all humankind.[186]

> **Activities in the Area are to be carried out for the benefit of humankind as a whole, taking into particular consideration the interests and needs of developing states.**

5.2. Would deep-sea mining be of benefit to humankind?

> ***"We currently have neither the knowledge nor the data required to assess whether humankind stands to lose more than we could gain if the ISA opens the deep ocean to industrial mining."***

Deep Sea Conservation Coalition[187]

The common heritage principle requires that deep-sea mining activities generate a benefit to humankind. Being able to accurately quantify the actual benefits from mining activities is therefore central to implementing the common heritage principle, requiring a consideration of costs and benefits, both economic and ecological.[188]

5.2.1. Compensation for loss of the common heritage of humankind

There remains considerable uncertainty surrounding the economic outcomes and viability of deep-sea mining activities.[189] Deep-sea mining is technically challenging, taking place in extreme conditions (high pressure, low temperatures and in darkness) at depths of up to 4000 metres and beyond. It is largely unproven at the commercial scale[190] and requires significant capital and operational expenditure.[191] Revenue generation is highly uncertain, dependent on market prices which are tied to the demand for metals which is in itself highly unpredictable (see **Section 9.1**). Deep-sea deposits of some minerals are also huge compared to current market size, potentially depressing prices should additional supply enter the global market,[192] with implications for revenue generation. These factors, among others, confound attempts to accurately forecast revenues from deep-sea mining activities,[193] and the compensation available for loss of the common heritage of humankind.

A proportion of the revenues generated by any future deep-sea mining operations would be paid to the ISA, which is responsible for sharing the benefits equitably between the ISA member countries/entities,[194] although the details of such a payment system are still to be determined.[195] To inform negotiations on this issue, the ISA commissioned the Massachusetts Institute of Technology (MIT) to produce a study analysing options for a royalty regime for nodule mining activities.[196] The study estimated the ISA's share of mining benefits in net present value at US$285-660 million over 30 years, dropping further once ISA's administrative costs are taken into account.[197] According to the Deep Sea Conservation Coalition (DSCC), the royalties generated would equate to around US$60,000-US$130,000 per year to each ISA member country[198] – insufficient compensation for the loss of the common heritage of present and future generations, while contributing very little to achieving the "overall development of all countries", a central aim of deep-sea mining as set out in UNCLOS.

The DSCC raises further concerns:

> *"To reach the equivalent of US$1 per person per year over the next 30 years, on the basis of the net present value used by MIT, the ISA would have to hand out several hundred mining contracts for nodules. A fraction of this number of mining operations would impact hundreds of thousands to millions of square kilometers of seabed, cause widespread damage, potentially flood the market for at least some of the metals found in the nodules (cobalt, copper, nickel, manganese) and depress prices. This would result in even lower royalty payments to the ISA, and bring negative impacts on the countries currently dependent on land-based mining. The sums do not add up to the "benefit to [hu]mankind as a whole" called for by UNCLOS."*[199]

The African Group of ISA member countries reached a similar conclusion, expressing their concerns regarding the financial benefits of deep-sea mining activities for humankind as a whole:

> *"In net present value terms the total compensation to mankind with a 2% and then 6% royalty would be $490 million. This represents just $2.93 million for each of the ISA's 167 members (excluding the EU) over the 30-year life of the exploitation contract. This means that each of these ISA members would receive on average in net present value terms, approximately $97.8 thousand per year. The African Group does not consider that this is fair compensation to mankind."*[200]

5.2.2. Damage to ecosystem services and environmental costs

When damage to ecosystem services and environmental costs are given due consideration, the case for deep-sea mining – in terms of the benefit to humankind as a whole – becomes increasingly untenable.

While the MIT study did not include environmental costs in calculating the potential value of royalties from nodule mining, the authors recognised the importance of such an analysis which they hoped would be conducted in future.[201] The failure to consider environmental costs or to value ecosystems and any damage to the services they

Fishing in Fiji. Credit: Tom Vierus / Ocean Image Bank

> Critically, the economic value of deep-sea ecosystem services is yet to be quantified, a prerequisite to estimating the flow of benefits that intact ecosystems provide to humankind and the costs to humankind arising from their destruction and degradation.

Fish is critical to food security across the Pacific, providing around 50-90% of animal protein consumed by coastal communities.

provide, among other aspects, has been highlighted as a major omission by environmental groups.[202] In November 2022, at its 27th session, the ISA Council adopted a long-awaited decision to conduct an economic study of environmental costs of deep-sea mining – a critical step towards making an informed assessment of the benefits of mining activities to humankind.[203]

Any such analysis will, however, be extremely challenging. There remains considerable uncertainty as to the full scale and extent of environmental impacts of mineral extraction – which is expected to cause significant damage well beyond areas approved for mining[204] – including the potential release of carbon from deep-sea stores and its impact on ocean acidification, and the implications of wastewater discharge and pollution from sediment plumes for commercial fisheries (see **Section 4**). The harm to deep-sea ecosystems and the wider ocean will, however, be unavoidable, with scientists now predicting the long-term and potentially irreversible loss of some ecosystems and a certain loss of biodiversity from deep-sea mining,[205] exacerbating existing pressures from pollution, overfishing and global heating.

Critically, the economic value of deep-sea ecosystem services is yet to be quantified, a prerequisite to estimating the flow of benefits that intact ecosystems provide to humankind[206] and the costs to humankind arising from their destruction and degradation. This is a significant unknown and one that may prove impossible to calculate. At present, we have very limited understanding of deep-sea ecosystems and the multitude of services they provide, including their role in carbon sequestration and global climate regulation. Beyond the economics of the issue is the need to consider the intrinsic value of deep-sea ecosystems that cannot be assigned a monetary value,[207] as well as the spiritual and cultural ties that remote island nations have with the sea.[208]

5.2.3. Alternative uses

The benefits of deep-sea mining to humankind are therefore far from evident. As some commentators argue, at present "there is little consensus on whether [seabed mining] is likely to yield net benefits or costs".[209] These uncertainties are further compounded by the need to consider the possible alternatives to deep-sea mining, including non-use, and the benefits that would derive from those uses to humankind.

> ***"...there is little consensus on whether [seabed mining] is likely to yield net benefits or costs"***
>
> Folkerson et al. (2019)[210]

Mineral extraction, which involves non-renewable resources, is only capable of generating one-off revenue, while other more sustainable uses of seabed resources may generate longer-term profit.[211] A possible example is the case of marine genetic resources – due its extremely high biodiversity, the deep sea may contain critical future pharmacological discoveries[212] and, indeed, deep-sea organisms have been found to possess compounds with antimicrobial activity that could be used to develop treatments for cancer, infectious diseases and other illnesses.[213] While the use of marine genetic resources must itself be carefully considered in line with marine ecosystem protection and access and benefit-sharing considerations, as Jaeckel (2020) points out, UNCLOS was negotiated without knowledge of marine genetic resources, and at a time of "false promises regarding the economic potential of seabed mining".[214] It is critical that such uses be duly factored into analyses of the benefits to humankind, including their potential to contribute to the Sustainable Development Goals (SDGs).

5.3. How will any potential benefits and costs be distributed?

Not only are the benefits to humankind unclear and open to question, there is a significant risk that allowing deep-sea mining to proceed would exacerbate global inequalities, in direct conflict with the key UNCLOS principles of equitable benefit-sharing, of prioritising the needs of developing states, and of promoting international cooperation for the overall development of all countries.[215] Benefits will largely accrue to a handful of states and corporations based in wealthy nations, with developing states bearing the disproportionate burden of environmental risks and harm. The accrual of these benefits to a highly selective, narrow, overwhelmingly wealthy set of interests and the impact of the true costs on the global population are a profoundly important and wholly unacceptable illustration of environmental injustice.

5.3.1. A minority of nations and corporate interests stand to profit

An analysis of the exploration contracts concluded to date highlights that political and economic interests in mineral extraction are concentrated among a limited number of state and non-state (private) entities.

5.3.1.1. Analysis of the key players

Currently 21 states are engaged in or linked to exploration activities, either as state parties or as sponsoring states for state-owned enterprises or private entities (see **Table 4**) and potentially stand to benefit from mining activities over and above the royalties shared between all 167 states via the ISA (see **Section 5.2.1.**).

Table 4: Overview of sponsoring state interests in exploration contracts (all types of mineral deposit, both private and state entities) (based on data from ISA (undated), 'Exploration Contracts', accessed 27.01.2023)

	State	State or private contractor	Number of contracts	% of total contracts	Exploration area	% of total exploration area (according to published contracts)	Reserved area**	% of total reserved area allocated
1	China	State	5	16.1	234,797	17.9	72,745	17.0
2	Korea	State	3	9.7	88,000	6.7		0.0
3	Russian Federation	State	3	9.7	Not public			
4	France	State	2	6.5	85,000	6.5		0.0
5	Germany	State	2	6.5	87,230	6.7		0.0
6	India	State	2	6.5	85,000	6.5		0.0
7	Japan	State	2	6.5	78,000	6.0		0.0
8	UK	Private	2	6.5	133,539	10.2		0.0
9	Belgium	Private	1	3.2	74,990	5.7		0.0
10	Brazil	State	1	3.2	3,000	0.2		0.0
11	Cook Islands	Private	1	3.2	73,177.64	5.6	71,937	16.8
12	Jamaica	Private	1	3.2	Not public			
13	Kiribati	Private	1	3.2	74,990	5.7	74,990	17.5
14	Nauru	Private	1	3.2	74,830	5.7	74,830	17.5
15	Poland	State	1	3.2	10,000	0.8		0.0
16	Singapore	Private	1	3.2	58,280	4.4	58,280	13.6
17	Tonga	Private	1	3.2	74,713	5.7	74,713	17.5
18	Consortium*	State	1	3.2	75,000	5.7		0.0
		Total	**31**	**100.0**	**1,310,546.64**	**100.0**	**427,495**	**100.0**

Notes:

*Interoceanmetal Joint Organization: Bulgaria, Cuba, Czech Republic, Poland, Russian Federation, Slovakia

**As at January 2019: ISA (2019). *Current Status of the Reserved Areas with the International Seabed Authority*. Policy Brief 01/2019. https://www.isa.org.jm/files/files/documents/statusofreservedareas-01-2019-a.pdf

China holds exploration rights to the largest area overall, accounting for 234,797 square kilometres of the international seabed, or 18% of the total area under exploration contracts to date (based on data in published contracts).

Deep-seabed communities form isolated pockets of life, with a high proportion of species found nowhere else on earth, and even species observed only on polymetallic nodules. © GEOMAR

Of the 31 exploration contracts concluded to date, 22 have been awarded to governments or state-owned enterprises, 19 of which are held by only 7 countries (China, Russia, South Korea, France, Germany, India and Japan). Of these, considering only those contracts awarded to individual governments and state-owned enterprises (i.e. excluding consortia),[216] China alone accounts for nearly one quarter of contracts issued, followed by the Russian Federation and Korea, which together account for around 28% of contracts.

China holds exploration rights to the largest area overall, accounting for 234,797 square kilometres of the international seabed, or 18% of the total area under exploration contracts to date (based on data in published contracts). Of this, 72,745 square kilometres are reserved areas, equating to 17% of the total allocated reserved areas as at January 2019 (**Table 4**).[217]

Since 2011, when the ISA issued the first contracts to non-state actors,[218] the sector has become increasingly dominated by private enterprises, who have emerged as the lead proponents of deep sea mining.[219] Currently, almost a third of the 31 exploration contracts (9 in total) are held by private (non-state) entities – exclusively for nodule mining in the CCZ. Private entities hold half of the contracts for nodule mining exploration (9 of 19 contracts), representing 45.6% of the contracted exploration area (**Table 5**). Private entities are now the dominant interest in exploration activities in the CCZ in terms of number of contracts (9 of 17 contracts).[220]

Table 5: Exploration contracts for polymetallic nodules by type of contractor (state/private)*

Type of contractor	Exploration area (sq km)	% of total exploration area	Reserved area (sq km)**	% of total reserved area
State	674,027.00	54.4	72,745.00	17.0
Private	564,519.64	45.6	354,750.00	83.0

Notes:

*Based on information in published contracts on the ISA website: ISA (undated), 'Polymetallic nodules', accessed 16.02.2023, https://www.isa.org.jm/exploration-contracts/polymetallic-nodules

**As at January 2019: ISA (2019). *Current Status of the Reserved Areas with the International Seabed Authority*. Policy Brief 01/2019. https://www.isa.org.jm/files/files/documents/statusofreservedareas-01-2019-a.pdf

Private sector exploration activities are dominated by three corporations headquartered in developed nations: (1) The Metals Company (TMC) (formerly DeepGreen), headquartered in Canada; (2) UK Seabed Resources (UKSR), a subsidiary of US-based Lockheed Martin; and (3) Belgian corporation Dredging, Environmental and Marine Engineering NV (DEME) (**Table 6**). Ocean Mineral Singapore Pte. Ltd (OMS), a subsidiary of Singapore-based Keppel Offshore and Marine, and Jamaican-registered corporation, Blue Minerals Jamaica (BMJ), a subsidiary[221] of Swiss-registered group Allseas (**Box 2**), also each hold an exploration contract for polymetallic nodules. Allseas is also an operational partner in TMC's NORI project (**Box 3** below).

> ***"If those companies [with exploration contracts] are permitted to mine the international seabed, the vast majority of profits will flow to the high net-worth individuals and multi-billion dollar investment companies or corporate conglomerates who own the companies' shares"***
>
> Deep Sea Conservation Coalition[222]

Far from being equitably shared across humanity, the potential profits from deep-sea mining activities are thus set to flow to some of the world's largest economies, and to the shareholders and investors of a handful of private sector mining companies, located overwhelmingly in the Global North.[223] Economic benefits to sponsoring states are expected in the form of profits to state-owned enterprises, and through the taxation of profits of private mining companies[224] – however, it is not evident in several cases (as in the case of TMC – see **Box 3**) that the state sponsoring the ISA contract is the same country in which significant tax will be paid (see also **Section 5.3.1.2** below).[225] Thus while several developing states act as sponsoring states for contracts held by private entities, the extent to which these countries stand to benefit from mineral extraction remains unclear. This is a critical issue of both environmental and social justice, particularly in light of the risks and liability these developing states will assume as sponsors (**Box 5**).

5.3.1.2. Compliance with the requirement for 'effective control'

Contracts for mining activities may be held by ISA state parties, or by state-owned enterprises or non-state actors where sponsored by an ISA member state (see **Section 3.2.3** above).[226] UNCLOS requires that private entities possess the nationality of their sponsoring state, or be effectively controlled by the sponsoring state or their nationals.[227] If the applicant is effectively controlled by another state party or its nationals, that state party must co-sponsor the applicant.[228] In the case of applications concerning reserved areas (see **Section 5.3.1.3** and **Table 6**), applicants must be sponsored AND effectively controlled by a developing state.[229]

The ISA's interpretation of effective control is highly questionable. In practice, the ISA has interpreted the requirement for 'effective control' based on the low threshold of 'regulatory control',[230] namely the registered location/nationality of incorporation of the applicant, rather than economic control.[231] By equating effective control with the nationality of the sponsoring state, and using the exact same evidence to determine whether either requirement is satisfied, this interpretation confounds two distinct conditions for a state to act as sponsor (possessing the state's nationality OR being effectively controlled by the state/its national),[232] rendering the requirement for effective control essentially meaningless, **possibly in direct violation of the letter and spirit of UNCLOS.**[233]

By deferring to the discretion of the sponsoring state to determine whether the applicant is eligible for sponsorship, **the ISA has also declined to 'lift the corporate veil' to look at the controlling entity behind an applicant to determine if a co-sponsor is required for the application.** This is a specific requirement of UNCLOS[234] that does not appear to have been implemented in practice. In many cases, there are strong indications that effective control lies with much larger foreign entities, including corporations headquartered in Canada (TMC), Belgium (DEME) and Switzerland (Allseas) (see **Boxes 2-3** and **Tables 1** and **6**). Similar questions also surround US giant Lockheed Martin's operations through its UK subsidiary, UKSR – the US is not a party to UNCLOS and would therefore be unable to act as a (co-)sponsoring state. In some instances applicants have declined to disclose the identity of the parent or ultimate controlling entity, hampering an assessment of effective control. This is exemplified by the most recent ISA exploration contract held by BMJ[235] in which the application referred to the involvement of an unspecified multinational enterprise[236] – evidence now reveals this to be a Swiss-registered corporation, Allseas (**Box 2**).[237]

Besides raising questions of compliance with UNCLOS, there are critical concerns around who stands to benefit from activities in these areas, which speaks to the equitable sharing of benefits from mining activities, an issue at the very heart of the UNCLOS regime.

Metalagorgia coral. © The Schmidt Ocean Institute

The ISA's reluctance to lift the corporate veil to determine the nationality of effective control has crucial implications for the allocation of reserved areas, which are specifically set aside for exploitation by developing states (see **Section 5.3.1.3**). In such circumstances, 'effective control' of a developing state is expressly required[238] – however, in practice, foreign entities based in developed states appear to exert significant control over contracts held by local entities in Pacific Island nations (see **Section 5.3.1.3** below and **Table 6**). Besides raising questions of compliance with UNCLOS, there are critical concerns around who stands to benefit from activities in these areas, which speaks to the equitable sharing of benefits from mining activities, an issue at the very heart of the UNCLOS regime.

> ***"Given the privileges awarded to developing states, it should be scrutinized whether such partnerships do not undermine the principle of the common heritage of mankind and the objective to realize benefits for mankind as a whole."***

Willaert and Singh (2021)[239]

The reality, today, is an apparent disconnect or absence of a 'genuine link' between sponsoring states responsible for ensuring compliance with contractual and environmental obligations (see **Box 5** below), and the entities that effectively manage the exploration (and potential future mining) operations.[240] Commentators warn of possible 'forum shopping' by private mining companies for favourable jurisdictions for sponsorship,[241] and the potential emergence of 'sponsoring states of convenience'.[242] A similar phenomenon ('flags of convenience') has seriously undermined enforcement of international rules and standards in the global fishing industry.[243]

The 2011 Advisory Opinion of the ITLOS recognised the need "to prevent commercial enterprises based in developed States from setting up companies in developing states, acquiring their nationality and obtaining their sponsorship in the hope of being subjected to less burdensome regulations and controls".[244] However, the corporate arrangements behind exploration contracts for the deep-seabed mining industry may display such characteristics. The ITLOS opinion further warned that "the spread of sponsoring states "of convenience" would jeopardize uniform application of the highest standards of protection of the marine environment, the safe development of activities in the Area and protection of the common heritage of mankind."[245] Unfortunately, based on developments over the past decade, it appears the ISA has failed to heed these warnings.

5.3.1.3. Access to reserved areas

As discussed above, a significant concern from a justice perspective is how companies based in the Global North have secured access to areas reserved for developing countries – using ostensibly local entities in predominantly small island developing states, which have in turn provided sponsorship for the ISA exploration contracts (see **Section 5.3.1.2, Table 1** and **Boxes 2-3**). This runs contrary to an essential pillar of the UNCLOS regime and the notion of reserved areas – to ensure developing states have equitable access to the resources of the international seabed.

Currently, private entities hold 83% of the total reserved area allocated to 'developing states' (**Table 5**). Despite access to reserved areas being restricted to applicants that are 'effectively controlled' by a developing state, (see **Section 5.3.1.2**)[246] Canada-based TMC alone holds the exploration rights to over half (52.5%) of the reserved area allocated via local subsidiaries/partnerships (**Table 6**). DEME and Keppel Offshore and Marine hold the remaining reserved areas allocated to private companies.

Table 6: Exploration contracts for polymetallic nodules held by private contractors (by controlling entity)

Overseas entity with a significant interest in the contract or effective control*	Country of HQ/ registered location	No. of contracts **	Exploration area (sq km)**	Reserved area***	% of total reserved area allocated
The Metals Company (TMC)[247]	Canada	3	224,533	224,533	52.5
Dredging, Environmental and Marine Engineering NV (DEME)[248]	Belgium	2	148,167.64	71,937	16.8
Lockheed Martin[249]	USA	2	133,539	-	-
Keppel Offshore and Marine[250]	Singapore	1	58,280	58,280	13.6
Allseas Group[251]	Switzerland	1	Not public	Not public	Not public
	Total	**9**	**564,519.64**	**354,750**	**83.0**

Notes:
*The overseas entity with a significant interest in or effective control of the contractor/contract has been identified based on publicly available data from, among others, credit check websites, company websites and corporate filings, and corroborated with the findings of previous investigations.
**Data from ISA (undated), 'Minerals: Polymetallic Nodules', accessed 27.01.2023. ***As at January 2019: ISA (2019). *Current Status of the Reserved Areas with the International Seabed Authority*. Policy Brief 01/2019. https://www.isa.org.jm/files/files/documents/statusofreservedareas-01-2019-a.pdf

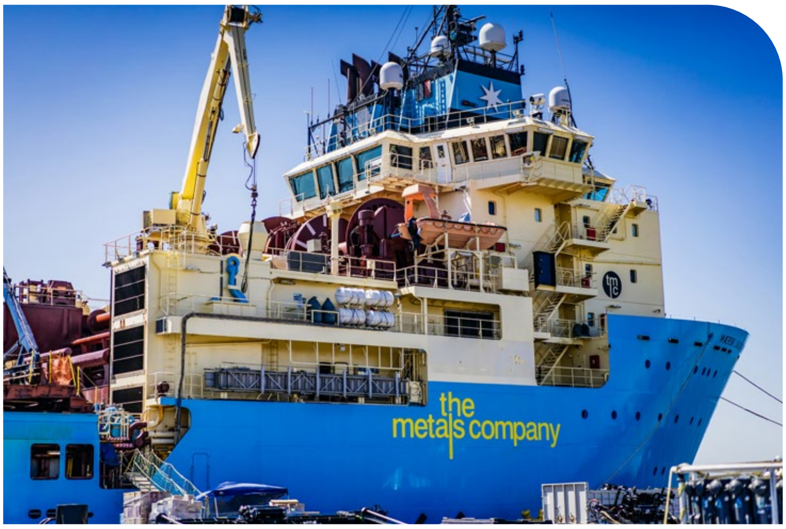
The decision to grant reserved areas to Singapore-sponsored OMS has attracted criticism. According to Greenpeace, at the time it received its exploration contract in 2015, Singapore was the third richest country in the world based on GDP per capita.[252] The fact that OMS is a subsidiary of the multinational Singapore-based corporation Keppel Offshore and Marine – a company with a history of allegedly using bribery to secure contracts worth millions of dollars – compounds these concerns.[253] OMS and its parent company Keppel are partnering with UKSR/Lockheed Martin – UKSR reportedly holds a 19.9% equity interest in a joint venture with OMS.[254]

"...certain Council members expressed uncertainty over the potential implications [of these arrangements], with regard to the issue of ownership and effective control, and the overall impact such an arrangement may have on the...concept of the common heritage of mankind"

ISA Secretariat[255]

"In the case of [Tonga Offshore Mining Ltd], Brazil said the explanation provided was insufficient to clarify the nationality of the entity for which effective control appeared to reside in Canada."

ISA Council (2011)[256]



The Metals Company's exploration vessel, the Maersk Launcher (source: www.businesswire.com). TMC is a lead proponent of deep-sea mining and one of the entities that stands to benefit most from opening up the international seabed to mineral extraction.

Box 2: Swiss-based offshore contractor Allseas enters a deep-sea mining contract through opaque arrangement with Jamaican subsidiary Blue Minerals Jamaica Limited

The opaque arrangements behind the most recently approved exploration contract held by Blue Minerals Jamaica Limited (BMJ) provide an insight into how corporations based in the Global North – in this case the Allseas Group – access deep-seabed resources through sponsorship by developing states. Like others before it, the contract raises questions of compliance with the provisions of UNCLOS on sponsorship and the equitable sharing of mining benefits, and highlights the increasing dominance of a handful of powerful corporations in activities concerning the 'common heritage of mankind'.

Very little has been reported about the ownership and management structure of BMJ – which holds an exploration contract starting in April 2021 – other than that a Danish offshore investment consultant, Peter Henrik Jantzen, is the company's executive director.[257] Jamaican and Swiss company accounts appear to show that the beneficial owner of BMJ is not Jantzen, the sponsoring state of Jamaica or indeed any of its nationals, but a company connected to the Swiss-headquartered multinational, the AllSeas Group[258] – a group specialised in offshore pipelay and subsea construction, also a shareholder[259] and operational partner of TMC. Together, TMC and Allseas recently completed one of the first-ever pilot tests for nodule mining in the CCZ.[260]

Incorporated in Jamaica in December 2018, BMJ initially listed a local Jamaican accountant as its sole shareholder, but he was just a name on paper, and not the company's real beneficiary.[261] Nearly two years later, on 28 October 2020, shares were transferred and issued to BMJ directors Mr Jantzen, and Mr Romeo Spinelli, an Italian businessman, giving the partners full ownership of BMJ through a Swiss-registered company, Jantzen & Spinelli Capital Power GMBH.[262] But Jantzen and Spinelli's shareholding of BMJ was short-lived with all shares transferred to yet another Swiss company, Blue Minerals Switzerland S.A, for an undisclosed sum in January 2021.[263]

Only a month earlier in December 2020, three directors had been appointed to BMJ's board, Luke Gillon, Cornelis Kooger and Gaston Baudet.[264] The new arrivals shared one thing in common: they were all directors at the multinational offshore contractor, the AllSeas Group.

Company documents show that the trio are also directors of Blue Minerals Switzerland, alongside the AllSeas founder and President, Heerema Edward Pieter, and Vanhoren Christopher André, another AllSeas director.[265] Blue Minerals Switzerland appears to be an AllSeas holding company, with Swiss corporate records stating that its purpose is to acquire and manage companies globally in the field of deep sea mining and offshore construction activities, on behalf of the AllSeas Group.[266] Despite BMJ being fully owned by Blue Minerals Switzerland (a company which operates for the Allseas Group), the ISA Council did not appear to seek to determine whether BMJ was effectively controlled by a Swiss national, as required under UNCLOS, and did not require BMJ to obtain a certificate of sponsorship from Switzerland.

Box 3: Concerns regarding The Metals Company's operations in the Pacific

TMC was established in 2011 and has its headquarters in Canada. Originally operating under the name DeepGreen, the company was founded by David Heydon, the founder of Canadian mining company Nautilus Minerals. Nautilus secured the first ever permit for deep seabed mining in 2011 in the territorial waters of Papua New Guinea; the so-called Solwara I project subsequently failed amid legal challenges and community opposition, leading to Nautilus filing for bankruptcy in 2019 and leaving the Government of Papua New Guinea (PNG) $120 million in debt (see **Box 4**). TMC's current CEO, Gerard Barron, was an early investor in Nautilus, reportedly turning a $226,000 investment into $31 million after the company went public, and successfully exiting his position after just six years.[267] TMC was formed in 2021 following the merger of DeepGreen with a 'blank check' special purpose acquisition company (SPAC),[268] Sustainable Opportunities Acquisition Corp (SOAC).

TMC is a lead proponent of deep-sea mining and one of the entities that stands to benefit most from opening up the international seabed to mineral extraction.[269] It is involved in three contracts sponsored by Pacific island nations for exploration activities relating to polymetallic nodules in the CCZ. These contracts involve three different contractors: Nauru Offshore Resources Inc (NORI) sponsored by Nauru; Tonga Offshore Mining Ltd (TOML) sponsored by Tonga; and Marawa Research and Exploration Ltd sponsored by Kiribati. NORI and TOML were originally incorporated as wholly-owned subsidiaries of Nautilus Minerals.[270] Control of NORI passed to TMC in 2011, while in 2020, TMC also acquired TOML and its ISA exploration contract, following the demise of Nautilus Minerals.

The manner in which TMC has gained access to exploration contracts in the Pacific raises significant concerns. The company's use of opaque corporate arrangements casts doubts over the extent to which Pacific island sponsoring states will truly benefit from mineral extraction,[271] given the risks they also assume as sponsors. TMC's management has cultivated extremely close ties with Pacific island governments and the ISA, with evidence pointing to the alleged corporate capture of the international regulator. A number of critical concerns are elaborated further below.

- *Misleading statements on corporate ownership and control in official ISA applications.* An update to NORI's 2008 application to the ISA for approval of its plan of work, submitted in 2011, claimed "NORI is no longer affiliated with Nautilus or any other entity or person outside of Nauru". TMC's wholly-owned subsidiary NORI was described as "wholly-owned by two Nauruan foundations", "corporately controlled by Nauruan nationals", with 100% of its shares held by Nauruan nationals.[272] TMC has subsequently disclosed that it holds a 100% interest in each of the two supposedly Nauruan foundations listed in NORI's 2011 ISA application.[273] According to a Greenpeace investigation, NORI has not undergone a change of control since its inception.[274] Marawa's application for an ISA exploration contract sponsored by Kiribati similarly made no mention of TMC (then DeepGreen), despite TMC, through its wholly-owned subsidiary DGE, entering into an agreement in 2013, "*granting DGE the exclusive right for 40 years to carry out exploration and collection in the Marawa Contract Area as well as purchase polymetallic nodules collected from the Marawa Contract Area.*"[275] The Marawa Exploration Contract was signed on 19 January 2015.[276] According to the World Bank, "*DeepGreen prepared and funded Kiribati's application in return for an off-take agreement*".[277] Critics have questioned the extent of involvement of Nauru, Tonga and Kiribati as sponsoring states, and whether they exercise 'effective control' over operations, as foreseen by UNCLOS (see **Section 5.3.1.2**).[278]

- *Access to areas for exploration activities reserved for developing countries*. Through these ostensibly local entities in Nauru, Tonga and Kiribati, TMC has gained effective access to 224,533 square kilometres of the CCZ for polymetallic nodule exploration. These are areas that had been previously reserved for developing states under the 'reserved areas' mechanism of UNCLOS (see **Section 5.3.1.3**).[279] TMC now holds the effective rights to over half of the seabed area designated as reserved for exploration by developing countries.[280] In a reversal of the process envisaged under UNCLOS, TMC is alleged to have obtained key data on the locations most valuable for mining activities, then sought sponsoring states to facilitate access. In the words of an international maritime lawyer and former Belgian delegate to the Seabed Authority, "*They have chosen tiny islands to gain access to the reserved areas. It is the exact opposite of what the law of the sea intended*".[281]

- *Uncertainty over potential benefits to sponsoring Pacific island states.* TMC, via its local entities, has entered into sponsorship agreements with the governments of Nauru and Tonga, undertaking to pay a "*seabed mineral recovery payment based on the wet tonnes of polymetallic nodules recovered from the tenement area*", once a minimum level of nodule production is reached, as well as an additional fee for administrative and other costs.[282]

However, the specific details of the payments to be made under these arrangements remain confidential,[283] despite calls for this information to be made public.[284] Greenpeace have suggested that revenues to Tonga could be a few million dollars per annum,[285] in contrast to ISA financial models predicting revenues in the region of hundreds of millions of dollars to sponsoring states.[286] Meanwhile, a community leader interviewed by the New York Times alleged that TMC had agreed to pay Tonga $2 per tonne as a 'mining production fee' – a figure that would amount to less than 0.5% of the total production value estimated by TMC.[287] The sponsorship agreement with Nauru appears to exclude the NORI Group (and thus TMC) from the payment of taxes related to exploration and exploitation, which would reduce total prospective revenue flows to the country.[288]

- *Influence over government decision-making and the ISA as regulator.* Several incidents point to the extent of TMC's alleged influence over the government of Nauru and the ISA as regulator. Nauru is the smallest island nation and third smallest country in the world, with a population of around 12,500.[289] The country – which has a colonial era mining history described as one of the world's worst environmental disasters[290] – has become an ardent supporter of deep-sea mining, working with TMC to release a film explaining the benefits of seabed mining to Pacific island nations and, as alleged by the Deep Sea Mining Campaign, using its influence as the 2019 chair of the Pacific Islands Forum to encourage other nations to get on board.[291] In June 2021, in an unprecedented move, Nauru triggered the 'two year rule' provision of UNCLOS, initiating a rush to finalise the Mining Code by July 2023 (**Box 1**). This development – which may be seen as an attempt to provide economic certainty to investors[292] – took place just a few months before TMC began trading on the Nasdaq Global Select Market (Nasdaq: TMC) on 10 September 2021.

Despite private companies being excluded from participating in ISA meetings, TMC's CEO, Gerard Barron, was permitted to address the February 2019 plenary session from the seat of the Nauruan delegation, from which he urged the Council to *"finalize the rules that will govern these resources in a commercially and environmentally responsible manner"*.[293] A recent investigation by the New York Times revealed how, starting in 2007, the ISA allegedly gave TMC critical information which enabled it to access some of the most valuable areas of the seabed, giving the company an advantage over its competitors.[294] The ISA has come under further criticism for a lack of transparency of key decisions, including the recent approval for TMC and its technical partner, Allseas, to conduct test mining which came to light in a TMC press release,[295] surprising observers (see **Section 7.2**).[296]

> The Metals Company has come under criticism for downplaying or failing to disclose material environmental, social and economic risks associated with deep-sea mining.

> ***"What is shocking is the way in which the ISA Secretary General and the Nauru Government have allowed DeepGreen to use their positions in an attempt to influence international and Pacific regional law and policymaking to serve the company's interests."***
>
> Deep Sea Mining Campaign[297]

- *Downplaying the environmental, social and economic risks associated with deep-sea mining.* TMC has come under criticism for downplaying or failing to disclose material environmental, social and economic risks associated with deep-sea mining. In July 2021, Greenpeace, the DSCC and Global Witness submitted a joint letter to the US Securities and Exchange Commission (SEC) highlighting shortcomings in TMC's prospectus filed as part of the process for listing on the Nasdaq stock exchange, including an alleged failure to credibly represent how it will manage the risk of untested mining of the deep sea floor.[298] This followed allegations raised in a Shareholder Advisory document published by the Deep Sea Mining Campaign including: (i) that deep-sea mining is inherently unsustainable; (ii) that TMC's business proposal is speculative and experimental; (iii) that liabilities due to environmental damage are insufficiently disclosed; and (iv) the existence of multiple political and internal governance risks, including potential challenges to TMCs interpretation of 'effective control' of its subsidiary by sponsoring states (see **Section 5.3.1.2**).[299] TMC is currently facing two class action lawsuits mounted by investors who allege that TMC made false and misleading statements, including downplaying "the environmental risks of deep-sea mining polymetallic nodules" and failing to "adequately warn investors of the regulatory risks faced by TMC's environmentally risky exploitation plans".[300]


A Papua New Guinean fisherman.
Credit: ARC CoE for Coral Reef Studies / Michele Barnes. (CC BY-ND 2.0)

The failed Solwara 1 project resulted in a loss for Papua New Guinea of around US$120 million – equivalent to almost a third of the country's annual health budget.

Box 4: Deep-sea mining in national waters – Nautilus Minerals' failed deep-sea mining project in Papua New Guinea

In January 2011, Papua New Guinea granted Nautilus Minerals (see **Box 3**) a 20-year mining lease to extract deep-sea mineral resources from the seabed within the country's exclusive economic zone (EEZ) – the world's first ever licence for deep-sea mining. The licence was granted for the commercial extraction of gold and copper from massive sulphide deposits around hydrothermal vents in the Bismarck Sea, in areas of around 1,600 metres depth.[301]

From the outset, the project, known as Solwara 1, came under heavy criticism from environmental and local groups. A report from the Centre for Environmental Law and Community Rights in Papua New Guinea and MiningWatch Canada detailed serious flaws in the company's Environmental Impact Statement, based on which the licence was granted, and a failure by the government's environmental approval process to protect the health of the marine environment, the livelihoods and well-being of coastal communities, and fisheries of national and regional importance.[302] In 2012, when the government of Papua New Guinea tried to terminate an agreement to purchase a 30% stake in the project alleging breach of contract, Nautilus Minerals initiated arbitration proceedings to compel the government to adhere to its contractual obligations.[303] In 2017, coastal communities launched legal proceedings against the government of Papua New Guinea, in an attempt to obtain key documents relating to the licensing and environmental, health and economic impacts of the project.[304]

In 2019, Nautilus Minerals collapsed into administration, after failing to obtain funding for the project. In January 2020, the government of Papua New Guinea declared the Solwara 1 project a failure that would "not get off the ground".[305] This resulted in a loss for the government of around US$120 million – equivalent to almost a third of Papua New Guinea's annual health budget.[306] In 2019, the country's then Prime Minister, Peter O'Neill, labelled the Solwara 1 project as a wasted venture that should not have happened.[307] Meanwhile, the effects of the failed project are still being felt by local people, who claim exploratory work has damaged marine life and disrupted cultural practices – including an ancient 'shark calling' tradition, which sees fishers rattle coconut shells in the water to attract sharks and capture them by hand.[308]

5.3.2. Developing states and vulnerable groups will bear the burden of risks and harm

It is highly doubtful that the considerable environmental, social and economic risks associated with mining projects would be offset by the potential benefits.[309] The failed deep-sea mining endeavour in the waters of Papua New Guinea, which left the country US$120 million in debt, underscores the significant risks associated with such projects (**Box 4**). Sponsoring states are exposed to substantial liability and financial risk – potentially being held liable for reparations in the event of environmental harm, should they fail to uphold their legal obligations as sponsoring states (see **Box 5**).[310] As Nauru has previously observed "these liabilities or costs could, in some circumstances, far exceed the financial capacities of Nauru [...] the State may potentially face losing more than it actually has."[311] Concerns have been raised as to whether sponsoring states such as Pacific island nations could be realistically expected to regulate the multinational parent companies of their sponsored contractors, considering limits on technical, financial and human resources and where they may lack effective control over these operations (see **Section 5.3.1.2** and **Boxes 2-4**). Numerous violations of the terms of ISA exploration contracts have already been reported[312] – failure by a sponsoring state to ensure compliance could leave the state open to liability for any damage to the marine environment that may result (**Box 5**).[313]

Box 5: Responsibilities of sponsoring states

Sponsoring state responsibilities fall under two categories. The first category, direct obligations under international law, include obligations to apply a precautionary approach, to apply best environmental practices and to conduct environmental impact assessments (EIA).[314] As obligations imposed directly on sponsoring states by UNCLOS, states cannot avoid potential liability by merely ensuring contractors comply with ISA rules, as these may be insufficient to meet the standard required under international law.[315] States may further be held liable even where the ISA itself has failed to act to ensure compliance. The obligation to apply a precautionary approach also implies a degree of proactive monitoring and action to prevent environmental harm, in view of the extensive scientific uncertainties associated with deep-sea mining. If a sponsoring State does not meet these EIA and monitoring obligations, it could be held liable for harm caused by any resulting damage.

The second category is an indirect obligation to ensure contractors comply with the provisions of UNCLOS, the ISA regulations and their contracts[316] through, among other things, adoption of regulatory and administrative measures that are reasonably appropriate for securing compliance by persons under their jurisdiction.[317] According to the Seabed Disputes Chamber, this consists of a duty of due diligence in overseeing the activities of their sponsored entities that requires states to "deploy adequate means, to exercise best possible efforts, [and] do the utmost to ensure contractors comply with their obligations".[318] This a high standard that potentially increases for more risky, untested activities such as deep-sea mining.[319]

"Considering the wide range of potential impacts seabed mining could have on the marine environment, on resources such as fisheries and minerals, and even on people and property, the need for proactive monitoring of the mining activities of the contractor and the high level of scientific uncertainty about the extent of harm that could occur there is significant risk that sponsoring States could be held liable for substantial costs for damage caused by the activities of their mining contractor."

Duncan Currie, political and legal advisor to the Deep Sea Conservation Coalition[320]

Deep-sea mining has the potential for significant environmental harm that threatens to severely impact vulnerable groups. Many of these impacts are poorly understood, including major unknown implications for the global carbon cycle (**Section 4.4**). Paradoxically, given the purported climate agenda driving the race to begin mining, disturbance to the seabed could impair the ocean's ability to sequester carbon and limit global heating. This would have potentially devastating consequences for communities on the frontlines of the climate crisis – including the 10% of the global population living in areas less than 10 metres above sea level,[321] many of whom live in small island developing states[322] and in coastal zones across the Global South.

Local and Indigenous communities, which rely heavily on marine resources for their food security and livelihoods, will likely shoulder the major burden of deep-sea mining activities (see **Box 4**). Deep-sea mining is predicted to negatively impact fisheries, causing potential declines in fish populations (**Section 4.3**).[323] In the Pacific, tuna fisheries are a critical source of revenue generation for Pacific island nations,[324] accounting for an average of 37% of government revenue, or up to 84% in some cases.[325] A recent study published in Marine Policy found that developing island nations such as Samoa and the Cook Islands, which take as much as 20% of their high seas tuna catches within areas subject to mining exploration, could be potentially disadvantaged by deep-sea mining impacts on tuna fisheries.[326]

While the exact spatial extent of mining impacts is currently unknown, recent modelling of pollution discharged by operations in the Tonga-sponsored contract area (see **Box 3**) observed it would take only three months to reach the waters of Hawaii and Kiribati.[327] Scientists also warn of the potential for bioaccumulation of toxins in food webs, with possible risks for human consumption.[328] This is a significant concern, with fish critical to food security across the Pacific, providing 50-90% of animal protein consumed by coastal communities across a broad spectrum of Pacific island countries/territories, where per capita fish consumption exceeds the global average by more than 3-4 times.[329] Mining operations further risk disrupting local cultural traditions and deep-rooted spiritual connections to the ocean, as highlighted by the impacts of exploration on the local shark calling tradition in Papua New Guinea (**Box 4**).[330]

> In the Pacific, tuna fisheries are a critical source of revenue generation for Pacific island nations, accounting for an average of 37% of government revenue, or up to 84% in some cases.

Credit: Moss (CC BY-NC 2.0)

6. Legal considerations – the need for precaution

6.1. The ISA has a legal obligation to protect and conserve the marine environment

The ISA has a clear mandate under UNCLOS to protect and conserve the marine environment, its biodiversity, and ecosystems. Article 145 of UNCLOS provides that "necessary measures shall be taken [...] to ensure effective protection for the marine environment from harmful effects which may arise from [activities in the Area]". This obligation applies both to states parties and the ISA,[331] which is specifically required to adopt appropriate rules and regulations to prevent "hazards [and] harmful interference with the ecological balance of the marine environment" and "damage to the flora and fauna".[332] In particular, such rules and regulations must be adequate to:

"secure effective protection of the marine environment from harmful effects directly resulting from activities in the Area or from shipboard processing immediately above a mine site of minerals derived from that mine site, taking into account the extent to which such harmful effects may directly result from drilling, dredging, coring and excavation and from disposal, dumping and discharge into the marine environment of sediment, wastes or other effluents".[333]

The ISA is responsible for ensuring that plans of work for the exploration and exploitation of deep-sea mineral resources comply with the provisions of UNCLOS and with applicable environmental regulations.[334] In cases where "substantial evidence indicates the risk of serious harm to the marine environment", the ISA Council has both the authority and the obligation to "disapprove areas for exploitation by contractors".[335] The ISA regulations for the exploration of deep-sea mineral resources further provide that "prospecting shall not be undertaken if substantial evidence indicates the risk of serious harm to the marine environment".[336]

The concept of "serious harm to the marine environment" is defined in the ISA regulations as "any effect from activities in the Area on the marine environment which represents a significant adverse change in the marine environment determined according to the rules, regulations and procedures adopted by the Authority on the basis of internationally recognized standards and practices".[337]

The Council is also empowered to issue emergency orders for the "suspension" of operations in the Area "to prevent serious harm to the marine environment".[338]

The ISA's mandate to protect our ocean is essential to safeguarding the ecosystem services the deep sea provides for the benefit of humankind (**Section 5**).

6.2. The need for precaution

To fulfil its mandate, the ISA must draw on the best available science[339] to assess the potential impacts of deep-sea mining, and take informed decisions based on sound scientific evidence to ensure that mining does not cause serious harm to the marine environment. When exercising its powers under UNCLOS, the ISA is under an obligation to apply a precautionary approach.[340]

While the precautionary principle is not explicitly mentioned in UNCLOS, treaty provisions have to be interpreted in their context.[341] Context for the purpose of treaty interpretation includes "any subsequent agreement between the parties regarding the interpretation of the treaty or the application of its provisions", as well as "any relevant rules of international law applicable in the relations between the parties".[342] This applies in particular to principles of international environmental law, which must be taken into account when interpreting treaties concluded before the development of that body of law.[343]

The precautionary principle, which is widely recognised and implemented by states and is often considered to have become part of customary international law,[344] constitutes a relevant rule of international environmental law applicable in the relations between the parties. While there is no consistent definition of the precautionary principle, guidance can be found in several international treaties that define the precautionary principle, and constitute "subsequent agreements regarding the interpretation or application" of UNCLOS. Under the Agreement for the Implementation of the Provisions of UNCLOS relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, "the absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures."[345] Under the Convention for the Protection of the Marine Environment of the North-East Atlantic, the precautionary approach is defined as requiring preventive measures "when there are reasonable grounds for concern that substances or energy introduced, directly or indirectly, into the marine environment may [...] harm living resources and marine ecosystems [...], even when there is no conclusive evidence of a causal relationship between the inputs and the effects".[346]

It follows that, consistent with a precautionary approach, the ISA is under an obligation to take preventive measures to safeguard the marine environment where there are "plausible indications of potential risks", even if the evidence is insufficient to fully predict the extent and magnitude of the potential negative impacts.[347]

6.3. Substantial scientific evidence establishes a risk of serious environmental harm

Substantial and concordant scientific evidence clearly establishes the existence of a risk of significant adverse changes in the marine environment occurring as a result of deep-sea mining. As scientific knowledge of the deep sea accumulates to reveal the richness, diversity, and value of deep-sea ecosystems (**Section 2.1**), as well as their vulnerability to disturbance (**Section 2.2**), the risk of serious and irreparable harm to this invaluable environment and to the biosphere as a whole has become evident (**Section 4**). Based on available scientific evidence, it is clear that, at a minimum, deep-sea mining is "highly likely to cause inevitable and permanent biodiversity loss".[348] The evidence is therefore more than sufficient to establish "plausible indications of potential risks", and requires the ISA to take preventive measures to protect the marine environment, consistent with a precautionary approach.

6.4. The ISA Council must apply a precautionary approach and not allow deep-sea mining to proceed

Although substantial scientific evidence already establishes a clear risk of serious harm to the marine environment, the precise extent and magnitude of the damage likely to be caused, potentially on a global scale, by deep-sea mining remain unknown. In view of the uncertainty surrounding the environmental repercussions of deep-sea mining, it is impossible to ensure that deep-sea mining will not cause serious harm to the marine environment.

It is furthermore impossible to ensure that deep-sea mining will generate a benefit for humankind as a whole, as required by UNCLOS.[349] As a matter of fact, the projected economic benefits of deep-sea mining expected to be redistributed to states parties are insignificant[350] and pale in comparison to the cost that an environmental disaster would generate for generations to come (**Section 5**). As a matter of law, under UNCLOS the ISA's obligation to ensure that activities in the Area are carried out for the benefit of humankind as a whole cannot justify derogating from its equally important obligation to protect the marine environment. On the contrary, the imperative of environmental protection is integral to the ISA's mandate to safeguard the common heritage of humankind.

The ISA must take stock of the risks posed by deep-sea mining and fulfil its mandate by taking appropriate measures to protect and preserve the marine environment under Article 145 of UNCLOS. The nature of such measures depends on the likelihood and seriousness of the risk. In certain cases, a total ban is the sole possible response to a given risk.[351] Alternatively, when the scientific evidence cannot be assessed conclusively, potentially harmful activities may be temporarily prohibited.[352] For instance, the International Tribunal for the Law of the Sea relied on the lack of scientific certainty to order states to refrain from conducting an experimental fishing programme involving the fishing of southern bluefin tuna in the Pacific.[353] At the very least, caution dictates that potentially harmful activities be not permitted to proceed when the available evidence establishes a clear risk of environmental harm, even if it is insufficient to assess the full extent and severity of the harm.

Based on mounting scientific evidence highlighting the risks of deep-sea mining (see **Section 4**), an increasing number of states have called for a precautionary approach to either permanently ban deep-sea mining (France),[354] or temporarily defer, halt or prohibit mining operations until sufficient scientific evidence is available to allow for informed decision-making (Chile,[355] Costa Rica,[356] Ecuador,[357] Federated States of Micronesia,[358] Fiji,[359] Germany,[360] New Zealand,[361] Palau,[362] Panama,[363] Samoa,[364] Spain,[365] and Tuvalu[366]) (see **Section 8**). Such views calling for a moratorium or "precautionary pause" are reflected in the Biodiversity Strategy adopted by the European Commission in the framework of the UN Convention on Biological Diversity:

"*marine minerals in the international seabed area cannot be exploited before the effects of deep-sea mining on the marine environment, biodiversity and human activities have been sufficiently researched, the risks are understood and the technologies and operational practices are able to demonstrate no serious harm to the environment, in line with the precautionary principle*".[367]

In view of the significant gaps in current scientific knowledge, the ISA is not in a position to make fully informed decisions to regulate the modalities of mining operations and must therefore refrain from allowing deep-sea mining to proceed. Several measures can immediately be adopted by the ISA, either independently or in combination, to ensure that no harm is caused to the marine environment as a result of deep-sea mining (**Box 6**). Such measures would be fully compatible with the letter and spirit of UNCLOS.

> In view of the significant gaps in current scientific knowledge, the ISA is not in a position to make fully informed decisions to regulate the modalities of mining operations and must therefore refrain from allowing deep-sea mining to proceed.

Box 6: Recommendations to the ISA based on the application of the precautionary principle

In view of the substantial scientific evidence establishing a clear risk of serious and irreversible harm to precious ecosystems and biodiversity, the ISA must fulfil its general obligation to take measures to protect and conserve the marine environment for the benefit of all of humankind under Articles 145 and 140(1) of UNCLOS. In particular, the ISA Council must, consistent with a precautionary approach:

(i) pursuant to Article 162(2)(x), disapprove areas for exploitation;

(ii) pursuant to Articles 162(1) and 163(9), establish a specific policy directing the Legal and Technical Commission to defer issuing recommendations regarding applications for approval of a plan of work for exploration or exploitation;

(iii) refrain from approving plans of work for exploration or exploitation; and

(iv) ensure that any regulations provisionally adopted by the Council are adequate to effectively protect and conserve the marine environment, notably by requiring evidence that a proposed plan of work would not cause any biodiversity loss or damage to marine ecosystems.

In parallel, and pursuant to Article 143(2) of UNCLOS, the ISA should support and promote scientific research in the Area, with a view to:

(i) improving scientific knowledge of the biodiversity and functioning of deep-sea ecosystems and of the services they provide for humankind; and

(ii) assessing the full extent and magnitude of the disturbance and damage likely to be suffered by marine ecosystems and wildlife as a result of deep-sea mining, as well as impacts on fisheries, the oceanic carbon cycle, and climate regulation, with due consideration for cumulative impacts.

7. The need for reform of the ISA

It is increasingly clear that the ISA is unfit as a regulator to achieve its dual mandate of protecting the marine environment (discussed in **Section 4**) and ensuring activities in the Area are carried out for the benefit of all of humankind (discussed in **Section 5**). This section highlights some of the key concerns raised to date, which support the urgent need for reform of the ISA's institutional structures and decision-making processes.

Under UNCLOS, the ISA is obliged to conduct an institutional review every five years. In light of this review, the ISA Assembly may take, or recommend that other organs take, measures that would lead to the improvement of the governance regime for the international seabed.[368] The last review was conducted in 2017, but has not yet been carried out for 2022. This periodic review process provides a critical opportunity to address the issues outlined below, and those raised elsewhere,[369] in view of intensifying global concerns regarding the risks and potential impacts of deep-sea mining on fragile marine ecosystems and the global carbon cycle. Until transparent and accountable structures for managing the deep-sea commons are in place, the credible governance needed to regulate the international seabed as the common heritage of humankind cannot be ensured.

7.1. Structural issues and potential conflicts of interest

Currently the ISA is financed through member state contributions, however, in the long-term it will be funded by revenues from the deep-sea mining contracts it issues.[370] It is therefore in the ISA's interest for commercial mining operations to commence as soon as possible, as this is central to its future funding. According to a 2019 report of the UK Parliament's House of Commons Environmental Audit Committee, the fact that *"the ISA, the licensing body for seabed exploration, also stands to benefit from revenues...is a clear conflict of interest."*[371]

The composition of the ISA Council is also skewed towards deep-sea mining interests. Eight of the Council's 36 member states are elected based on criteria with a pro-mining bias, namely from state parties which are major importers of minerals of the categories derived from the Area (Group A: four members), or have made large investments in the conduct of mining activities in the Area (Group B: four members). These two groups each form one of the Council's four chambers for decision-making purposes. The criteria for electing the representatives of "special interests" of developing states

Until transparent and accountable structures for managing the deep-sea commons are in place, the credible governance needed to regulate the international seabed as the common heritage of humankind cannot be ensured.

Galaxy siphonophore. Although a siphonophore appears to be a single organism, each specimen is actually a colony composed of many individual animals. © The Schmidt Ocean Institute

(Group D: six members) also includes states which are major importers of minerals derived from the Area, and states that are potential producers of such minerals, potentially skewing the Council's composition further towards pro-mining interests. Only half of the Council's members are elected according to the principle of ensuring an equitable geographical distribution of seats in the Council.[372] The DSCC raises a further concern that states which are themselves contractors (i.e. that hold exploration contracts through government research agencies or state-owned enterprises) are also members of the Council "allowing them to effectively negotiate rules for themselves".[373]

These structural issues have crucial implications when it comes to decisions to approve or reject applications (plans of work) for exploration or exploitation. As discussed in **Section 3.2.1** above, if the LTC makes a recommendation to the Council to approve a plan of work, the plan of work is effectively considered approved after a certain period of time, unless a majority of two thirds of the members of the Council present and voting, *including a majority of members present and voting in all four chambers*, decide the application should be rejected.[374] Given that two of the four chambers are elected on the basis of pro-mining criteria – with one chamber specifically composed of states with a direct interest in deep-sea mining activities – it is difficult to see how decisions about an application could be made impartially, which raises doubts as to whether the majority required to reject an application could ever be reached. Indeed, the Council is yet to reject a plan of work for exploration that the LTC has recommended for approval.

As a result of these constraints, the 41 members of the LTC – who are elected by the ISA Council[375] which is itself biassed towards mining interests – possess (near) *de facto* power to make decisions on mining contracts. It is incomprehensible that decisions of such critical importance for the future of the 'common heritage of humankind', lie in the hands of the LTC – a non-democratically elected body, unrepresentative of humanity as a whole and whose opaque decision-making procedures provide little to no opportunity for effective oversight or participation (**Section 7.2**).

There are further concerns regarding the independence of ISA officials, including ISA Secretary-General,[376] Michael Lodge. Internal documents obtained and published by the New York Times, indicate a close relationship between Lodge and TMC's CEO Gerard Barron,[377] while Lodge has also appeared in TMC's promotional videos.[378] The New York Times investigation also revealed how the ISA allegedly handed over classified data to TMC executives, providing the company with key information about the most lucrative sites in Reserved Areas[379] (see **Sections 3.2.3** and **5.3.1.3**), before they had a contract to partner

It is difficult to see how decisions about a [exploration or exploitation] application could be made impartially, which raises doubts as to whether the majority required to reject an application could ever be reached.

with a developing nation.[380] Business representatives have also been permitted to "roam freely" among international delegates during delicate negotiations,[381] while private contractors have even spoken on behalf of their sponsoring state delegations at ISA meetings – for example, representatives from TMC and DEME who addressed the February 2019 session of the ISA Council from the official seats of Nauru and Belgium, respectively (see **Box 4**).[382]

> ***"The [ISA] provided data identifying some of the most valuable seabed tracts, and then set aside the prized sites for the company's future use."***
>
> Eric Lipton, New York Times[383]

7.2. Procedural lack of transparency and accountability

Despite the ISA's mandate to act for the "benefit of [hu]mankind as a whole", the authority has been criticised for a concerning lack of transparency which has restricted access to information and participation of key groups.[384]

> ***"Because current ISA practices do not generally reflect international best practices in transparency, ensuring accountability from either the institution or its contractual parties engaged in mining will be difficult."***
>
> Ardron et al. (2018)[385]

As discussed in **Section 3.2.1** above, the LTC plays a critical role in ISA decision-making, and particularly in the approval of plans of work submitted by contractors. If the LTC recommends that a plan of work be approved, the Council must adopt it, unless rejected by a two-third majority of Council members, including a majority in all four chambers. Yet, despite making recommendations with critical implications for the future of the global commons, the LTC's decisions and procedures are highly opaque. Recommendations on mining applications are made based primarily on confidential information which is shared with neither the ISA Council[386] nor the public. While contractors submit annual reports on their activities to the LTC and ISA Secretariat, these are also not made publicly available.[387] Key meetings of the LTC are conducted behind closed doors,[388] and detailed meeting minutes are not published, but summarised in the chair's report to the Council, with crucial details anonymised. This has precluded informed discussions in the Council and Assembly on key issues: Council members have, for example, complained that the heavily redacted nature of reports hinders their ability to assess compliance by contractors and whether non-compliance is persistent.[389] Such lack of transparency characterises not only decisions with commercial implications, but also environmental and regulatory discussions – matters which in principle do not require secrecy.

A striking example of this lack of transparency is the ISA's recent approval of a deep-sea mining test in the Clarion-Clipperton Zone, which permitted TMC's subsidiary, NORI, to carry out pilot nodule collection trials. The decision was made by a small sub-group within the LTC through use of the online 'silence procedure'[390] (a procedure introduced during the COVID-19 pandemic for use in "exceptional cases" and intended only for time-sensitive matters of a procedural nature[391]), without prior consultation of the Council and despite the LTC and stakeholders having expressed extensive concerns regarding NORI's Environmental Impact Statement (EIS) submitted in July 2022.[392] To the surprise of ISA member states, on 7 September 2022, TMC announced that NORI had been granted authorisation for the mining test in a press release.[393] When the ISA's press release followed a week later, neither the LTC's recommendation nor the additional information submitted by NORI on its EIS were made available to the ISA state parties or to the public.[394] The move was heavily criticised by Belgium, which demanded clarification in the Council meeting as to why and when the authorisation had been approved by the ISA and whether it violated procedural requirements.[395] Costa Rica also raised concerns about the contents of NORI's EIS, the submission and publication process, and the process of stakeholder consultation,[396] a concern echoed by other states including Germany and New Zealand.[397]

To date, the approval of exploration contracts, and the most recent decision to authorise test mining, have been made without the open and transparent consultation of state parties to the ISA or relevant stakeholders. Despite the absence of a Scientific Committee (identified as a structural deficiency of the ISA in view of its explicit environmental protection mandate)[398] and only around a fifth of the current LTC members having a relevant background in the field of environmental protection[399] (for example, ecology, marine biology or conservation)[400] decisions have been taken without the consultation of civil society on the possible environmental impacts of mining activities[401] or, indeed, the meaningful participation of potentially impacted groups. This is especially concerning given the limited channels for reviewing ISA decisions once adopted.[402]

Controversial procedural incidents have also occurred during ISA negotiations to develop the Draft Exploitation Regulations,[403] which will form part of the Mining Code. Access to the ISA Assembly meeting in August 2022 was highly restricted, with only a limited number of civil society actors permitted to attend and a number of journalists excluded from the meeting.[404] Observers, including NGOs and scientists, were reportedly "relegated to a windowless basement room for the duration of the meetings", which restricted their ability to participate,[405] and were limited to just a few minutes for their interventions.[406] During the meeting, the live web stream was disconnected at the start of crucial negotiations, only to be turned back on after fierce debate among countries.[407] The ISA's decision not to renew its contract with the Earth Negotiations Bulletin – which since 2017 had been providing daily summaries of ISA sessions – has been heavily criticised,[408] removing a key public record of ISA meetings.[409]

"Rather than acting on behalf of all of humankind, the ISA continues to demonstrate a deep-rooted industry driven agenda. Silencing voices that question the path to extraction, including NGOs and scientists, during negotiations illustrates the Authority's clear and inherent conflict of interest."

Emma Wilson, representing OceanCare throughout negotiations[410]

"On the whole, ISA practices appear to operate below expected UN standards, and there remains a need for clearer, more predictable and more advanced procedures for open and inclusive public participation, in line with human rights norms. In effect, the ISA should arguably set higher public participation standards than other international organizations because of its unique powers (regulatory and monitoring), its mandate to benefit humankind, and its lack of accountability within the UN system."

Morgera and Lily (2022)[411]

8. Opposition is building

A growing number of governments, parliamentarians, scientists, NGOs and businesses are calling for a halt to deep-sea mining in areas beyond national jurisdiction, as a result of serious concerns over the impacts on marine biodiversity and highly vulnerable ecosystems. Critically, an increasing number of private companies have voiced concerns about deep-sea mining and publicly committed not to purchase minerals from the deep seabed,[412] throwing doubt on the business case for commercial mining.

> With such widespread opposition, the question is: how can deep-sea mining be justified as in the interests of all humankind?

Opposition to DSM – Groups that have voiced opposition or concern over deep-sea mining

GOVERNMENTS AND PARLIAMENTARIANS

- Pacific and Oceania: Palau, Fiji, Samoa, Federated States of Micronesia ("Moratorium Alliance"), New Zealand
- Europe: France, Germany, Spain
- Latin America: Costa Rica, Chile, Panama, Ecuador
- European Commission and the European Parliament
- 250 parliamentarians from over 50 countries
- IUCN World Conservation Congress*

COMPANIES

- BMW Group
- Google
- Patagonia
- Philips
- Renault Group
- Rivian
- Samsung SDI
- Scania
- Volkswagen Group
- Volvo Group
- Microsoft

FINANCIAL INSTITUTIONS

- ABN AMRO
- BBVA
- Cooperative Bank
- Lloyds Banking Group
- NatWest (previously Royal Bank of Scotland)
- Standard Chartered Bank
- Triodos Bank
- The European Investment Bank
- Storebrand
- Credit Suisse

FISHING SECTOR

- African Confederation of Professional Artisanal Fishing Organisations (CAOPA)
- EU's Long Distance, North-western Waters and Pelagic Advisory Councils (LDAC, NWWAC and PELAC)
- International Pole and Line Foundation
- Norwegian Fisheries Association
- SATA (South Africa Tuna Association)
- SAHLLA (South African Hake Long Line Association)

SCIENTISTS AND CIVIL SOCIETY ACTORS

- 704 marine science and policy experts from over 44 countries have signed a statement calling for a pause to deep-sea mining.
- Over 400 civil society organisations from across the world have joined a DSCC initiative calling for a moratorium on deep-sea mining.

* 81 governments and government agencies from 37 countries voted in favour of the motion calling for a moratorium. 577 NGOs and civil society organisations also voted in favour.

To date, groups that have voiced opposition or concern over deep-sea mining activities include:

Political entities

- In September 2021, a motion calling for a moratorium on deep-sea mining was adopted with almost unanimous support by the IUCN World Conservation Congress. Altogether 81 governments and government agencies from 37 states voted in favour of the motion.[413]

- In June 2022, at the United Nations Ocean Conference, the President of Palau launched an alliance calling for a moratorium on deep-sea mining. Fiji, Samoa and the Federated States of Micronesia have since joined the alliance.

- New Zealand, Germany, Costa Rica, Chile, Spain, Panama and Ecuador have called for a moratorium or precautionary pause on deep-sea mining in international waters.

- In his opening speech at COP27, President Emmanuel Macron announced that "France calls for a ban on all exploitation of the deep seabeds."[414]

- The European Commission has called for deep-sea mining to be prohibited until "scientific gaps are properly filled, no harmful effects arise from mining and the marine environment is effectively protected".[415] The European Parliament has also called on EU member states and the Commission to support a moratorium on deep-sea mining "until the effects of deep-sea mining on the marine environment, biodiversity and human activities at sea have been studied and researched sufficiently and deep seabed mining can be managed to ensure no marine biodiversity loss nor degradation of marine ecosystems".[416] The Council of the EU has meanwhile expressed support for efforts done by EU Member States "to establish a sound regulatory regime on potential future deep-sea mining that is based on the precautionary principle as well as on the highest environmental standards and sufficient scientific knowledge, in order to ensure that such activity would not cause harmful effects to the marine environment in the Area."[417]

- 250 parliamentarians from over 50 different countries have signed a global parliamentary declaration calling for a moratorium.[418]

Businesses and financial institutions

- Major companies have signed a business statement supporting a moratorium on deep-seabed mining including car manufacturers BMW, Volkswagen and Volvo, global electronics corporations Samsung and Philips, and technology giant Google and have committed not to use metals produced from deep-sea mining until the environmental risks are "comprehensively understood".[419]

- Banks and financial institutions have joined calls for a deep-sea mining moratorium, including ABN AMRO, Lloyds Banking Group, Natwest, BBVA Bank, Standard Chartered and The European Investment Bank.[420]

- The United Nations Environment Programme Finance Initiative, in a briefing to its members, has stated that: "there is no foreseeable way in which the financing of deep-sea mining activities can be viewed as consistent with the Sustainable Blue Economy Finance Principles".[421]

- Microsoft has established a moratorium on using minerals sourced through deep-seabed mining until the proper research and scientific studies have been completed.[422]

- In December 2022, Norway's largest private asset manager Storebrand announced it would no longer invest in companies involved in deep-sea mining and that TMC would be excluded from investment with immediate effect.[423]

- Credit Suisse is also among the financial service providers that have excluded financing for the exploration or extraction of seabed minerals.[424]

- Other companies such as Ford, General Motors, Daimler, and Tiffany & Co. are members of the Initiative for Responsible Mining Assurance (IRMA), and will only source metals from IRMA-certified mines. IRMA does not allow its system of certification to be used by deep-sea mining companies.[425]

- Fishing sector associations and bodies are also calling for a moratorium, including the African Confederation of Professional Artisanal Fishing Organisations (CAOPA), the EU's Long Distance, North-western Waters and Pelagic Advisory Councils (LDAC, NWWAC and PELAC)[426], and the International Pole and Line Foundation (INPLF).

Scientists and civil society actors

- To date, more than 700 marine science and policy experts from over 44 countries have signed a statement recommending the "transition to the exploitation of mineral resources be paused until sufficient and robust scientific information has been obtained to make informed decisions."[427]
- Over 400 civil society organisations from across the world have joined a DSCC initiative calling for a moratorium.[428]

> ***"We believe it is not worth the risk. We ask all of you to support that deep-sea mining increases the vulnerability of the seabed and marine life. How can we in our right minds say let's go mining without knowing what the risks are?"***

Surangel Whipps, Jr. President of the Republic of Palau[429]

9. Is deep-sea mining needed?

Proponents often cite the need for deep-sea mining to meet the increasing demand for minerals such as copper, cobalt, nickel, lithium, silver and rare earth metals in the context of the clean energy transition and global emissions reduction commitments. These metals are used in renewable energy technologies, including rechargeable batteries for electric vehicles, solar photovoltaic generators and wind power plants.

9.1. Projected future demand for minerals

According to the International Energy Agency, global efforts to reach the goals of the Paris Agreement would mean a quadrupling of mineral requirements for clean energy technologies by 2040.[430] A study conducted by the University of Leiden predicts that to successfully implement the goals of the Paris Agreement by 2050, global production of relevant metals needs to grow twelvefold.[431] Meanwhile, the World Bank estimated in 2017 that electric storage batteries would increase mineral demand in that sector by 1000% to achieve 2°C global temperature warming scenarios.[432]

Ain Beni Mathar Integrated Combined Cycle Thermo-Solar Power Plant.
Photo: Dana Smillie / World Bank. (CC BY-NC-ND 2.0)

Such projections are, however, highly uncertain. They are unable to take into account innovations in battery technologies, which are developing rapidly and will significantly impact the mix of metals and materials that will be used, and thus levels of demand, in the coming years.[433] As a World Bank study notes, with battery technology rapidly evolving, it is almost impossible to forecast which technologies will be most used up to 2050.[434] An analysis by RMI concludes that the rapid evolution of battery technologies has set in motion "a seismic shift in how we will organize energy systems as early as 2030" – new battery chemistries are expected to compete with the prevailing lithium-ion (Li-ion) technology,[435] such as solid-state technologies which can be lighter and provide more range at lower cost.[436] Battery technologies that require neither nickel nor cobalt (two of the key targets of deep-sea mining), such as lithium-iron-phosphate (LFP) batteries, have seen their market share rise to 18.5% in January 2021 compared to just 1% in January 2020.[437] In April 2021, Chinese electric vehicle giant BYD announced that it planned to remove cobalt, nickel and manganese from its vehicle batteries entirely through a shift to LFP.[438]

"Solid-state technology, in particular, is poised to massively disrupt the storage industry by unlocking new opportunities for cheap, safe, and high performing batteries, including non-lithium-based chemistries."

Rocky Mountain Institute[439]

"Uncertainties are particularly high for cobalt: while today 57% of the global cobalt production is used for Li-ion batteries...these batteries come in a number of different sub-types, which have different cobalt contents with some requiring no cobalt at all. Shifts in sub-type preferences and chemistries already led to a declining cobalt demand per battery storage capacity and it is expected that this trend will continue."

Manhart and McLennan (2023)[440]

According to a recent study commissioned by Greenpeace, claims made by deep-sea mining proponents that polymetallic nodules are needed to secure the supply of raw materials for future lithium-ion battery production are misleading. Not only do nodules not provide lithium or graphite, which are the two most supply-critical battery raw materials, the main raw materials targeted by nodule mining (cobalt and nickel) are substitutable for less supply-critical materials (**Figure 5**). Furthermore, copper and manganese, the other key targets of nodule mining, are mainly used in other applications – an increased demand for Li-ion batteries would have a negligible impact on global demand for these minerals and would not require a significant expansion of mining activities, the study concludes.[441]

Figure 5: Overview of Li-ion battery raw materials

	Graphite	3 Li Lithium 6.94	29 Cu Copper 63.546	25 Mn Manganese 54.938	27 Co Cobalt 58.933	28 Ni Nickel 58.693
Can be produced from polymetallic nodules	No	No	Yes	Yes	Yes	Yes
Current share of world supply used for Li-ion batteries	7%	29%	0.01%	0.2%	57%	5%
Substitutable	Yes	No*	No	Yes	Yes	Yes
Substitution materials	Li	-	-	Co, Ni, Al, Fe, P	Ni, Fe, P, Mn	Co, Fe, P, Mn

Indispensable raw materials for Li-ion battery production (Graphite, Li, Cu)

Raw materials largely used in other sectors (Cu, Mn)

Substitutable raw materials for Li-ion battery production (Mn, Co, Ni)

* Substitutable only through shifts to battery types other than Li-ion or Li-metal (e.g. Na-ion batteries)

Source for share of world supply used for Li-ion batteries: Co: (Cobalt Institute 2022) Graphite, Mn, Ni: (DERA 2021); Li: (Ding et al. 2020); Cu: calculated using the following data: total annual Li-ion battery production: 2 million t (assumption based on (Jacoby 2019)); Cu-content of batteries: 12% (DERA 2021), total annual Cu-production: 24 million t (DERA 2021).

Source: Manhart, A. & McLennan, A. (2023). *The rush for metals in the deep sea. Considerations on deep-sea mining.* Study for Greenpeace e.V., Freiburg. February 2023.

Box 7: Impact of price fluctuations on metal use and substitution

Increases in mineral prices can incentivise companies to innovate in the search for alternatives. A striking example is the case of neodymium magnets which are used in wind turbines.[442] Neodymium is a rare earth mineral which can also be found in manganese nodules and is another target in the deep-sea mining industry.[443] It was generally assumed that neodymium magnets were very difficult to substitute, but after a price peak of neodymium in 2010, producers found ways to substitute 20-50% of neodymium magnets with other technologies.[444] Similar experiences have been documented in the electric vehicle industry. Originally, Tesla used Nickel Cobalt Aluminium Oxide (NCA) cells in its cars. To increase its profit margins, it introduced the cheaper lithium-iron-phosphate (LFP) battery cell free of nickel and cobalt. When prices for raw materials soared in early 2022, Tesla responded by increasing the number of cars manufactured with LFP batteries.[445]

> ***"It is plausible that increasing cobalt prices will lead to substitution effects towards other metals such as nickel, manganese, iron and phosphate (which are partly already observed today)."***

Manhart and McLennan (2023)[446]

Projections often assume continuity of the current linear model of production and give insufficient consideration to the role of recycling and recovery of metals when modelling future demand (see also **Section 9.2** below). Recycling can play a major role in reducing primary demand for battery metals used in electric vehicles,[447] which can be improved and expanded to metals not currently recovered, or recovered only at low rates.[448] Current recycling rates of high-demand metals such as silver, lithium, neodymium and dysprosium are less than 1% – an increase in recycling would improve production rates and reduce incentives to mine new sources of supply.[449] Primary demand for metals for solar panels can also be reduced through improved efficiency of material use, given the long lifespan of these products.[450] According to the World Bank study cited above, end of life recycling would reduce the amount of primary copper, nickel and cobalt used by 2050.[451] In November 2021, Swedish battery manufacturer Northvolt announced that its recycling program, Revolt, had produced its first ever lithium-ion battery cell featuring a nickel-manganese-cobalt cathode produced from metals recovered through the recycling of battery waste.[452]

> ***"Between 25-55% of projected demand for [electric vehicle] batteries over the next two decades could be offset by optimizing battery metal recovery...[R]ecovery rates of above 90% are technologically feasible for all four metals [copper, lithium, nickel and cobalt.]."***

Institute for Sustainable Futures[453]

> ***"...insufficient collection and recycling [of mobile phones] cause annual losses of more than 16,000 tons of cobalt. This is roughly equivalent to 10% of the world's annual cobalt production and more than the planned full-scale production of [TMC] after 2030."***

Manhart and McLennan (2023)[454]

Other studies contradict the assertion – made largely in isolation by the mining industry itself – that deep-sea mining is required to meet future demand for minerals. A report published in 2016 by the Institute of Sustainable Futures found that, even under the most ambitious scenario – a transition to a 100% renewable energy economy on a global basis by 2050 – demand for the metals required can be met without mining the deep-sea, but from known terrestrial resources as well as improved recycling of metals.[455] According to the report, cumulative demand for silver and lithium is estimated to be less than 35% of known terrestrial resources, whilst the demand for all other metals considered – copper, cobalt, nickel – represents less than 5% of existing resources. The authors further note the possibility that new terrestrial resource discoveries could occur before 2050.[456] Indeed, over the past 25 years, the number of known lithium reserves increased by a factor of ten, while cobalt, nickel and copper reserves have more than doubled.[457] A study commissioned by the International Seabed Authority similarly found that the terrestrial supply of key deep-sea metals is around 60 years of resources for nickel, 100 years for cobalt and more than 100 years for copper, and that deep-sea mining could actually increase a metal surplus for copper and cobalt.[458]

> ***"A transition towards a 100% renewable energy supply can take place without deep-sea mining. Metal demand associated with the dominant renewable technologies evaluated in this report, even assuming very aggressive growth rates under the most ambitious future energy scenarios, do not require deep-sea mining activity."***

Institute for Sustainable Futures[459]

9.2. The way forward – a circular economy

> ***"Deep-sea mining to extract raw materials would promote the continued exploitation of Earth's resources, substantially expand humankind's "footprint" on the planet, and potentially undermine efforts to transform economies by perpetuating unsustainable, single-use consumption."***

Deep-sea Conservation Coalition[460]

There is an acute risk that deep-sea mining will create a self-fulfilling prophecy, increasing in intensity in response to demand and sidelining investment into sustainable solutions. In countries such as the UK and Germany, this linear "take, make, waste" economic model, built on ever-increasing resource extraction to meet our endless consumption, means we currently require around three planet Earths to satisfy our resource needs.[461]

Instead, we must reduce demand for virgin metals and build a circular economy – extending product life cycles, introducing the right to repair, and scaling up systems for reuse and recycling. The circular economy is a model of production and consumption which seeks to ensure our economies are designed, our products made, and our consumption aligned within planetary boundaries. A key goal is to use extracted materials for as long as possible and, once a product's lifetime is over, to recover minerals and loop them back into new products.[462]

There is an acute risk that deep-sea mining will create a self-fulfilling prophecy, increasing in intensity in response to demand and sidelining investment into sustainable solutions.

The Electronics Recycling Centre, Edmonton, Canada. Credit: David Dodge, The Pembina. (CC BY-NC-SA 2.0)

Circular Economy. Credit: RecondOil (CC BY 2.0)

A study commissioned by WWF found that the cumulative demand of lithium, cobalt, nickel, manganese, rare earth elements, platinum and copper can be reduced by 58% compared to the scenario laid out by the International Energy Agency to achieve net-zero emissions by 2050[463] – if the right decisions towards a circular economy, and in recycling and technology are made.[464]

Increasing recycling rates for minerals will require improvements in recovery rates of certain elements such as lithium (currently around 1%), cobalt (32-74%), nickel (57%) and manganese (53%). For lithium, a recovery rate of 80% is possible based on best available technology, while for cobalt, nickel and manganese, potential recovery rates are 90-95%.[465] Investments in recycling infrastructure are also required to increase the amount of materials collected (currently only 5% of batteries and 5% of fuel cells are being sent for recycling).[466]

Regulation can set mandatory targets for battery recycling, the recovery of materials and extended producer responsibility, and establish end-of-life requirements, including collection targets and obligations. An example is the provisional agreement on the EU Battery Regulation, which aims to promote a circular economy by regulating batteries throughout their lifecycle.[467] The agreement, amongst other things:

- Sets out targets for producers to collect waste portable batteries (63% by the end of 2027 and 73% by the end of 2030) and waste batteries for light means of transport (51% by the end of 2028 and 61% by the end of 2031)
- Sets the target for lithium recovery from waste batteries to 50% by 2027 and 80% in 2031
- Provides for mandatory minimum levels of recycled content for industrial, SLI batteries[468] and EV batteries. These are initially set at 16% for cobalt, 85% for lead, 6% for lithium and 6% for nickel.[469]

Urban mining and landfill mining can make a critical contribution to a circular economy. Urban mining describes the process of recovering materials from products, buildings, waste and other infrastructure, while landfill mining involves the recovery of materials from active and inactive landfills, of which an estimated 500,000 exist only within the EU.[470] The German Environment Agency has pointed out the potential of urban mining, highlighting the enormous stocks of minerals contained in existing items and structures that can easily exceed a country's available natural deposits.[471] Recovering metals from e-waste – one of the fastest growing global waste streams (see **Box 8**) – has significant potential to reduce demand for virgin-mined metals, and may be more profitable than virgin mining.[472]

Box 8: Electronic waste – a precious resource

- In 2012, more than 60% of fully functioning television sets were replaced by German citizens for a newer device.[473]
- Today, 83 million mobile phones in the United Kingdom are shelved, another 45 million in Spain.[474]
- There are currently around 128 million tonnes of electronic equipment in the EU, Norway and Switzerland, or in other words, 244 kg per person;[475] and an additional 20 kg per capita are put on the market each year.[476]
- According to the European Environment Agency, "slightly less than half of waste electrical and electronic equipment enters official treatment,"[477] and an EU-funded consortium found that almost no critical raw materials are recovered in the EU, because it is not deemed as commercially viable.[478]
- In 2019, the raw materials contained in the EU's e-waste were worth US$ 12.9 billion.[479]
- The United Nations estimates that by 2030, global e-waste will reach a record high of 74.7 million tonnes[480].

Electronic waste at Agbogbloshie, Ghana.
Credit: Muntaka Chasant (CC BY-SA 4.0)

Extending product life cycles can further reduce the use of raw materials. This may be achieved through providing consumers with the information they require to repair their devices, or by incentivising corporations to renounce planned obsolescence and to offer 'lease' or 'pay-per-use' options.[481] Investing in lifestyle change and public shared infrastructure, such as public transport systems and cycling infrastructure, can further reduce the need for individual consumption of products such as electric cars that require minerals to power them.[482]

> ***"Rather than investing substantial public and private funding on technologies to extract metals from the deep ocean, we should be investing in developing sharing and circular economies and lifestyle change – innovating technology and systems that reduce the use of raw materials."***

Deep-sea Conservation Coalition[483]

Cold-water corals off Ireland in 750 metres of water. © MARUM – Center for Marine Environmental Sciences, University of Bremen (CC-BY 4.0)

10. Conclusions and recommendations

Governments must take steps to facilitate adoption of the circular economy ethos by countering greenwashing, ensuring reliable consumer information and promoting the 'right to repair'. Crucially, governments must take the lead to urgently establish pre-competitive, whole-of-government legislative frameworks that transform the carbon-based economies of today into circular models.

While the focus should be on transitioning from linear modes of production to a circular economy, we will still be dependent to some extent on primary extraction to enable the clean energy transition – especially in the interim, before recycled metals become readily available.[484] Priority, however, should be given to improving the yield of existing mining operations: the metal ore mining industry, for instance, discards 82% of exploited material as tailings and process slag, which still contains ore and other 'by-products' such as copper and nickel.[485]

Deep-sea mining proponents have repeatedly pointed out the social advantages over terrestrial mining: "[d]eep-ocean marine operations will not impact indigenous or native human populations, an increasing concern with land-based mine sites".[486] Terrestrial mining indeed has negative environmental and social impacts – including pollution, heavy metal contamination of water and soils, adverse health effects for workers and neighbouring communities[487] – while being implicated in human rights abuses such as child labour.[488]

However, expanding mining activities into deep-sea areas of unparalleled fragility, vulnerability and biodiversity, where risks are high and impacts likely irreversible, simply cannot not be the solution. Rather, the emphasis should be placed on promoting energy efficiency and circular models of production and consumption, and any expansion or intensification of terrestrial mining must be carefully considered and take place within significantly improved and fully enforced environmental, social and governance (ESG) frameworks. These must ensure human rights are respected throughout the lifetime of the mining operation, that waste is responsibly managed and that impacts on biodiversity and the environment are limited.[489] Emphasis must also be placed on responsible sourcing through verified certification schemes[490] and legal requirements for robust supply chain due diligence,[491] and the wider use of low-impact methods promoted.

The intact natural environment – the ocean especially – is our greatest ally in the fight against biodiversity loss and the climate crisis. **Yet just as the world stands on the edge of climate breakdown, humanity is on the threshold of introducing a new destructive industry: deep-sea mining.** With the potential to become the largest mining operation in history, this disruptive practice threatens thousands of square kilometres of the last pristine wilderness on earth.

Little do we know about the deep sea, but all scientific observations gathered so far indicate that it is crucial for the health of our planet. The deep sea hosts a myriad of living organisms essential to maintaining our global food supply, supporting rich biodiversity, and locking away CO_2 for millennia.

Mining this vital part of our ocean could be catastrophic, with potentially global and irreversible implications. Deep-sea mining risks disrupting the global carbon cycle, threatens fisheries and food security, and would lead to extensive and irreparable biodiversity loss with devastating consequences for both people and planet. The promise of exploitation for the benefit of humankind will not be fulfilled. Instead, similar to the fossil fuel sector, profits will be shared among a handful of powerful actors, with the heaviest burdens falling on developing states, vulnerable communities and future generations.

Critical gaps in our understanding of the deep sea prevent fully informed, science-based decision-making. **Against this background, an ever-increasing number of scientists, non-governmental organisations, businesses, policymakers, states and state-like entities stand up and strongly oppose deep-sea mining.**

Despite calls for precaution, the rush to develop a Mining Code with a view to allowing deep-sea mining continues, negotiated within a deeply flawed institution. The International Seabed Authority (ISA) has shown itself unfit for purpose, with troubling displays of conflict of interest and a significant lack of transparency and democratic decision-making, centred around just 41 'experts' whose recommendations can overrule the votes of democratically elected governments.

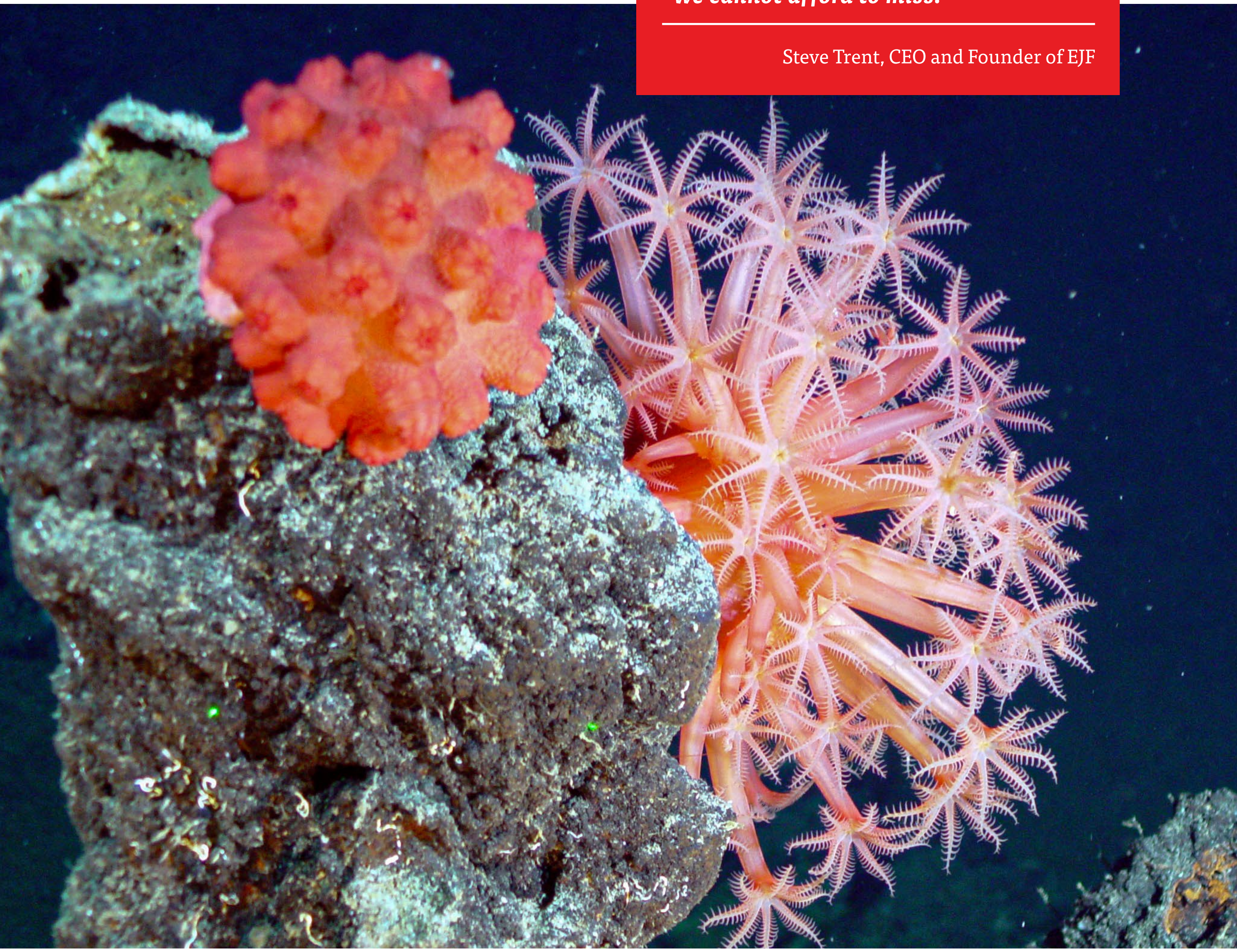
To make matters worse, the triggering of the Two-Year Rule has placed additional pressure on the ISA and international community to complete a Mining Code within just 24 months.

In order to achieve zero carbon emissions, we need to scale up efforts towards the green energy transition. But to open up the deep sea to excessive and devastating commercial mining cannot be the solution; nor can it be presented as the only viable way forward. On the contrary, deep-sea mining threatens to accelerate the catastrophe we are facing today and serves only to line the pockets of mining companies.

Only national negotiators can save the deep ocean now. The world's message to them is clear – listen to the growing tide of voices calling for a stop to deep-sea mining before it begins.

"This is a golden opportunity to stop the devastation before it even begins – one we cannot afford to miss."

Steve Trent, CEO and Founder of EJF



Octocorallia: Alcyonacea, mushroom coral. Submarine Ring of Fire 2002, NOAA/OER (CC BY-SA 2.0).

EJF urges the international community to stop the rush towards any deep-sea mining activity and the international legal framework that is to govern it – the Deep Sea Mining Code.

1. Stop Deep Sea Mining.

All efforts should be made by the international community, in particular governments and corporations, to prevent mining operations in the deep sea. The depths of the ocean contain some of the most biodiverse, undisturbed, and vulnerable ecosystems on the planet. All scientific evidence gathered so far indicates that the consequences will be devastating for the deep-sea ecosystem, with immense risks for the health of the ocean as a whole and the benefits it can provide for people. Moreover, the climate emergency requires a critical examination of the potential impacts of deep-sea mining activities on the carbon cycle.

2. Scale up investment in deep-sea research with a view to protecting our ocean and climate.

Critical gaps in our understanding of the deep sea prevent fully informed, science-based decision-making. The international community should support and promote scientific research on the deep-sea environment, with a view to improving our understanding of its functioning, its rich biodiversity and the ecosystem services it provides, including its role in the carbon cycle.

3. Invest in and implement circular economy solutions.

Both governments and industry must stop following the "take, make, waste" economic model, and transition urgently to a circular economy. This should include promoting and implementing large-scale electronics reuse and recycling programmes and the extension of product life cycles, and investing in energy efficiency and public shared transport systems to reduce the need for resource-intensive energy infrastructure. Investment should be upscaled into technological innovation, such as the development of less resource-intensive batteries to support the clean energy transition. The introduction of mandatory obligations for battery recycling and collection, end-of-life requirements, targets for the recovery of metals and extended producer responsibility will further reduce demand for virgin metals and align our needs with planetary boundaries.

4. Reform of the International Seabed Authority (ISA).

There is an urgent need to improve transparency and accountability of decision-making at the ISA – including through access to information and opportunities for meaningful public participation in deliberations of the Legal and Technical Commission (LTC) – and to address potential conflicts of interest through an independent periodic review process. In the absence of a Scientific Committee and in light of the ISA's clear mandate to protect the marine environment, the composition of the LTC should be reformed to significantly increase expertise in marine biology and conservation. While these reforms can be implemented immediately and will help to address major shortcomings in governance observed to date, there is a need for a broader overhaul of ISA structures and procedures, including the criteria for electing members to the ISA Council and the procedure for approving applications for exploration/exploitation. Until credible, transparent and independent governance structures for managing the deep-sea commons are in place, no democratic legitimate decisions about deep-sea mining can be made in the interests of all humankind.

5. Ensure the protection of deep-sea biodiversity.

In line with Target 3 of the Kunming-Montreal Global Biodiversity Framework, governments must designate at least 30% of the ocean – including national and coastal waters and the high seas – as ecologically representative, fully or highly protected marine areas (MPAs) by 2030, and provide the resources necessary to ensure they are monitored and fully enforced. Critical in achieving this, is the need to rapidly establish a comprehensive system of MPAs in areas beyond national jurisdiction with high standards of protection for marine biodiversity and ecosystems, in the framework of the recently agreed High Seas Treaty.

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63 *Ibid.*, Article 145.
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69 Elections are held every two years.
70 Article 162 UNCLOS and the Annex to the Implementation Agreement set out the Council's powers and functions in detail: the ISA Council can exercise law-making, policy-making, and supervisory competencies, including the power to establish specific policies on any matter within the competencies of the ISA (UNCLOS, Article 162). In particular, the Council decides over the approval of plans of work (Implementation Agreement, Annex, Section 3(11)), elaborates and adopts the Mining Code (UNCLOS, Article 162(2)(o); Implementation Agreement, Annex, Section 1(15) and (16)), and 'exercises control over the activities in the Area.' (UNCLOS, Articles 153(4) and 162(2)(l)). UNCLOS also confers competencies on the Council to ensure environmental protection, including the power to issue emergency orders (Article 162(2)(w)) on the basis of recommendations received from the Legal and Technical Commission (Article 162(2)(k)).
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Pte Ltd. See: Reuters (16.6.2015), 'Keppel Corp unit signs seabed exploration contract', accessed 7.2.2023, https://www.reuters.com/article/keppel-corp-contract-seabed-idUKL3N0Z23IL20150616. Ocean Mineral Singapore Pte Ltd (OMS), Keppel's subsidiary and holder of the contract, reportedly has a partnership arrangement with UKSR/Lockheed Martin. UKSR holds a 19.9% share in a joint venture with OMS according to UKSR's Annual Report and Financial Statements for the year ended 31 December 2021.

251 Exploration contract held by Blue Minerals Jamaica Ltd (BMJ) and sponsored by Jamaica. BMJ is a subsidiary of Blue Minerals Switzerland S.A., a holding company acting for the Allseas Group and directed by the same board of directors – see: Blue Minerals Jamaica Ltd (2022). *Annual Return for Companies with Shares for the period ending 12 December 2020*, obtained by EJF from the Companies Office of Jamaica; Federal Commercial Registry Office (ZEFIX) (undated). Blue Minerals Switzerland SA, accessed 31.1.2023, https://www.zefix.ch/en/search/entity/list/firm/1438678

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Anemone attached to a carbonate boulder.
Credit: Aquapix and Expedition to the Deep Slope 2007, NOAA-OE. (CC BY-SA 2.0)

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