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POLICY BRIDGE

The legal landscape for deep-sea mining in the Area: A primer for practitioners

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A general overview of the legal regime for managing deep-sea mineral resources of the seafloor in areas beyond national jurisdiction ('the Area') is presented with a focus on the protection of the marine environment. This primer aims to provide the background to and translate complex legal principles of international law relevant to activities related to deep-sea mining in the Area for those who do not have a background in legal studies. An introduction to international law, where it is relevant to deep-sea mining, is presented, as well as an overview of the United Nations Convention on the Law of the Sea, including its historical development. The role of the International Seabed Authority (ISA) in managing and regulating mineral-related activities in the Area is expounded, and a brief overview of the state-of-play regarding developments of the ISA Mining Code is represented, including calls for a moratorium on deep-sea mining by several ISA member states. Lastly, the role of other international legal frameworks pertaining to the Area and the protection of its environment is addressed. Overlaps in competencies between international and regional organisations are identified where they might lead to conflicts, providing as example a Marine Protected Area, designated by the Convention for the Protection of the Marine Environment of the North-East Atlantic, that partly intersects with the Area.

Keywords: Review, Marine resources, Mining code, UNCLOS, ISA, Deep-sea mining

1. Introduction

The idea of using seabed raw materials from the deep sea is not new and was already envisaged by Jules Verne in 'Twenty Thousand Leagues under the Sea' (1870). Shortly after, in 1873, the Challenger Expedition dredged up the first polymetallic nodules from the Atlantic seafloor (Belkin, 2021). The possibility of mining nodules, however, was not considered until nearly 100 years later when, in 1965, John L. Mero published his landmark book '*The Mineral Resources of the Sea*' (Mero, 1965). Mero is generally credited with the idea that nodules might be a valuable commodity – a scientific curiosum had become a resource (Sparenberg, 2007; 2019). Commercial interest, however, waxed and waned between the late 1960s and late 1980s, as did metal prices. This period also saw, on the back of decolonisation, a rise in the relative bargaining power of developing countries within the United Nations General Assembly (UNGA) with their calls for a 'New International Economic Order' to secure a more equitable distribution of global resources (Juda, 1979). Against this backdrop, the Maltese Diplomat Arvid Pardo first called for the recognition of the seabed and its resources in international waters as the Common Heritage of Mankind. The UN would formally recognise the principle in 1970 in UNGA Resolution 2749 (XXV). Eventually, this principle formed the core of the regime for the seabed and its subsoil in areas beyond national jurisdiction contained in the 1982 United Nations Convention on the Law of the Sea (UNCLOS; United Nations, 1982).

Market demands, political interests, the climate crisis and the necessity to reduce humankind's carbon footprint, along with geopolitical tensions, supply uncertainties and concerns about the impacts of terrestrial mining, are some of the reasons behind a revived interest in deep-sea minerals. The minerals contain so-called energy and defence-critical elements which are required for technology components used in, for example, electric car batteries, smart phones, transport of electricity, computer components, wind turbine magnets and photovoltaic cell components. For a fast transition from fossil fuel to renewable energies, these elements might be vital (e.g., Sakellariadou et al., 2022; Think Tank European Parliament, 2024; but see also, e.g., Levin et al., 2020; Amon et al., 2022a). Recently, the view on the sector has changed from

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'prohibitive due to huge technical challenges' to 'likely to become a reality soon' with successful demonstrations of the technical feasibility to collect nodules (Vink et al., 2022) and a full system test that included transport of nodules from the seafloor to the mining vessel (The Metals Company (TMC), 2022) in the Clarion-Clipperton Zone (CCZ). In Europe, the Norwegian Government announced in June 2024 plans to open areas of its continental shelf for licensing for the exploration of seabed minerals. In December 2024, the Government had to reverse this decision and deferred the plans for at least a year (Government.no, 2024). Meanwhile, India conducted a successful mining component trial in its own waters (Shankar, 2024), bringing the number of countries conducting explorative seabed mining activities including component testing in their own waters to 13 (Gales, 2024), and one operator announced commencement of the first commercial production of nodules from the CCZ in Quarter 4 of 2027 pending a U.S. permit (TMC, 2025).

As this sector evolves, so does the legal framework underpinning it (e.g., Young, 2020; Ardito and Rovere, 2022). Deep-sea mining is probably the only marine industry (except arguably offshore renewable energies) where a regulatory framework is being developed before exploitative activities commence and – debatably – the development is not completely driven by industry but by an international organisation, the International Seabed Authority (ISA). With the increasing awareness of the necessity of protecting our oceans and recent publications highlighting potential gaps in our understanding of even fundamental ecosystem processes of the deep sea (e.g., Amon et al., 2022b), deep-sea mining is also one of the few sectors where not only a high number of scientific articles are published (Frazão Santos et al., 2023), but where the development of the industry and its regulatory framework are discussed widely in the media (as attested by numerous newspaper and internet articles and podcasts).

The legal landscape of deep-sea mining is a complex one, and thus a comprehensive understanding of the mosaic of international, regional and national legal instruments making up this landscape is necessary for everybody working in this field (Willaert, 2021). This primer provides a comprehensive overview of this landscape, addressing the historical context, current regulations and the state of ongoing negotiations, the management framework, challenges, and future directions. It is intended for all stakeholders and interested parties in this sector who need a comprehensive understanding of the legal framework as a context for their work.

In this way, this primer includes a brief overview of those aspects of international law relevant to deep-sea mining before addressing the UNCLOS, the ISA and its Mining Code, legal requirements for contractors, the latest progress in the development of the necessary rules, regulations, standards and procedures as well as outstanding issues (up to and including September 2025), and the relevance of other legal frameworks and possible overlaps of those with the remit of the ISA. The focus of this special Elementa feature is on the mining of polymetallic nodules in the Clarion-Clipperton-Zone; the regulative framework for deep-sea mining of mineral resources in the Area, however, covers all seabed mineral types. Therefore, unless otherwise stated, the relevant rules and regulations mentioned in this primer apply to mining of cobalt-rich crusts, polymetallic sulphides as well as polymetallic nodules in the Area. In this article, we use the terms 'deep-sea mining' and 'mining activities' *sensu* UNCLOS Article 1 (3): 'activities in the Area' means all activities of exploration for, and exploitation of, the resources of the seabed in areas beyond national jurisdiction. Abbreviations are defined at first usage, but a glossary of abbreviations is also provided in Supplementary Table S1.

We are conscious that addressing every aspect pertaining to the protection of the marine environment in the context of managing the mineral resources in the Area is not possible within the limits of this article. We are also aware that by the time this article is published, discussions and negotiations at the ISA will have moved on. Notwithstanding these limitations, we hope to provide the reader with the necessary background required to set their own work – may that be of a scientific nature, in an advisory capacity or any other – into the wider context of this evolving legal landscape.

2. A short introduction to international law

The legal framework currently being developed for regulating and managing the exploration and exploitation of globally distributed deep-sea mineral resources must be understood in the context of international law irrespective of whether such activities occur in the Area or in national waters. International, regional and national legal instruments are at play in both jurisdictions with exploration and exploitation activities on a coastal state's continental shelf (*sensu* UNCLOS Article 76) being subject to a number of international rules and principles, while in the Area a contractor must adhere to the domestic laws of the state that has submitted a certificate of sponsorship for the contractor, that is, its sponsoring state (Willaert, 2021). Many scientists are not necessarily familiar with the area of international law, and thus we highlight in this section some basics of international law relevant to the understanding of the evolving legal landscape of deep-sea mining.

2.1. What is international law?

International law deals with the legal relations between states and, increasingly, certain non-state actors (e.g., intergovernmental and non-governmental organisations, multinational corporations that may be headquartered in a particular state but whose activities and operations occur across multiple jurisdictions, as well as individual persons), and can be understood as a set of principles, rules, norms, and standards that states and other actors are obliged to obey in their mutual relations (e.g., Simmons, 2012). Although international law operates largely through consent or customary practice – because in contrast to national law there is no universally accepted authority to enforce international law upon sovereign states – it is nonetheless accepted by states as binding

upon them (e.g., Charney, 1993). Given the structural realities of the international legal order, however, violations of international law can often occur without obvious consequence, that is, in the absence of directly punitive measures. Instead, responses to unlawful acts can take the form, among others, of withdrawal of aid, diplomatic pressure, international sanctions, and so on (Goldsmith and Posner, 1999). International law can be applied to individuals (e.g., international criminal law), but only states and intergovernmental organisations such as the UN or European Union (EU) can enter international legal agreements such as treaties and conventions. Aside from customary international law (also called international custom), international conventions (also known as treaties) are the most important source of international law (Statute of the International Court of Justice, Article 38). Customary international law can be defined as the collection of international behavioural regularities that nations over time come to view as binding on them as a matter of law (Goldsmith and Posner, 1999).

Legal disputes between states (and sometimes other actors) are settled in accordance with international law by a range of international courts and tribunals, for example, the International Court of Justice in The Hague. In contrast to domestic courts, however, this Court can only settle disputes if the states concerned have decided to accept the Court's jurisdiction (Statute of the International Court of Justice, 1945, Article 36). Many other specialist international courts and tribunals, however, do exercise forms of compulsory jurisdiction under the rules of particular treaties and regimes, as is the case under UNCLOS, and which will be further discussed below.

2.2. International legal agreements: Conventions and treaties

According to the 1969 Vienna Convention on the Law of Treaties (United Nations, 1969), a treaty is 'an international agreement concluded between States in written form and governed by international law, whether embodied in a single instrument or in two or more related instruments and whatever its particular designation'. The motivation behind calling for a convention or treaty is often the realisation that certain problems can only be adequately addressed at a global level (e.g., human rights, climate change, international trade). Conventions or treaties are an important source of international law and are based on the principle that a state is bound only by the rules of international law to which it has specifically consented. Entering a treaty is thus wholly voluntary, although there might be political (or economic) pressure on a state to accede to or, indeed, leave a treaty and thereby not be bound any longer by the treaty's provisions. The Vienna Convention provides the legal framework for the regulation of treaties between states including, among other things, their drafting, amendment, termination and interpretation (Aust and Dörr, 2012), though such rules are also broadly accepted as binding under customary international law. A convention may provide the remit for an intergovernmental organisation to, for example, develop and implement the legal framework necessary to address the subject matter of the agreement. By acceding to a treaty which forms the constituent instrument of an intergovernmental organisation – for example, UNCLOS – member states transfer the competence to the organisation required to fulfil its remit (e.g., ISA). Unlike customary international law, treaties are almost always in written form and often have built-in dispute resolution mechanisms such as international arbitration (Goldsmith and Posner, 1999), thereby potentially providing a stronger sense of legal obligation on states.

The implementation of treaties or the compliance with treaty obligations in international law is based on 'good faith'. As a further important source of international law, the principle of good faith acts to mediate the effects of states' rights in international law to achieve acceptable results when competing interests exist (Reinhold, 2013). This principle is inscribed in the general provisions of Part XVI of UNCLOS (Article 300), wherein 'States Parties shall fulfil in good faith the obligations assumed under this Convention and shall exercise the rights, jurisdiction and freedoms recognized in this Convention in a manner which would not constitute an abuse of right'.

Finalising a multilateral agreement is often a lengthy process. Upon adoption of a treaty, states are usually invited to sign it as a first step, thereby indicating their non-binding intent to comply with it. This first step must then be followed by ratification, or other accepted means of expressing consent to be bound by the agreement (Vienna Convention, Article 11). For multilateral treaties, providing for a fixed number of states to express their consent for entry into force is common (Vienna Convention, Article 24). For most international agreements, especially those dealing with ocean issues such as the International Convention for the Prevention of Pollution from Ships (MARPOL), the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) and UNCLOS, several years passed from the treaty opening for signature to its entry into force (Blasiak and Jouffray, 2024). There are many instances where states remain signatories of a treaty, but do not ratify it. For instance, 13 UN member states are signatories to UNCLOS but have not ratified the Convention (United Nations, 2025).

International and national law often interlink in their practical application. In states such as the United Kingdom (UK), which have a 'dualist' constitution, in order to fulfil some specific treaty obligations – that is, those that impact upon internal regulation and not merely interstate relations – such obligations must be transposed into domestic law to have practical effect within the legal system (Denza, 2018). For instance, in the UK, the EU's Habitats and Birds Directives (European Union, 1992; 2009) were transposed into the Conservation of Offshore Marine Habitats and Species Regulation 2017 for the UK continental shelf area (UK, 2017). Exemptions from this requirement are those treaty obligations which are by their nature inter-state and therefore do not require national legislation (e.g., in the field of diplomatic relations). In the context of deep-sea mining in the Area, a sponsoring state has the responsibility to ensure their sponsored contractor complies with the ISA regulatory regime. The sponsoring state's responsibility to ensure

such compliance applies within the state's legal systems and therefore requires the sponsoring state to adopt a regulatory regime and to take 'administrative measures which are, within the framework of its legal system, reasonably appropriate for securing compliance by persons under its jurisdiction' (UNCLOS, Annex III, Article 4(4)). In that way, this obligation of 'due diligence' is one of conduct rather than result, that is, a state exercises due diligence when it has taken 'all necessary and appropriate measures to secure effective compliance with its obligations' arising under international law and, specifically, those obligations included in an agreed Plan of Work (UNCLOS, Article 139; Oyarce, 2018). Conversely, state-sponsored contractors in the Area are obliged to adhere to the domestic laws of the sponsoring state, especially if these are 'more stringent that those in the rules, regulations and procedures of the Authority' (UNCLOS, Article 22). The full extent of these obligations, incumbent upon private contractors and sponsoring states alike, especially in terms of environmental protection, was laid down forcefully by the International Tribunal for the Law of the Sea (ITLOS) in the 2011 Advisory Opinion of its Seabed Disputes Chamber (ITLOS, 2011, especially paragraphs 205 and 209). We return to this Advisory Opinion in the next section.

3. A constitution for the oceans: UNCLOS

The 1982 United Nations Convention on the Law of the Sea, called 'The Convention' (or UNCLOS), provides the legal framework for the governance of the oceans and all activities therein (Lothian, 2023). Considered to be one of the most important legislative achievements of international law, this 'Constitution for the Oceans' (Koh, 1982) remains a cornerstone in ocean governance. The intention behind the Convention was to settle 'all issues relating to the law of the sea' (UNCLOS, Preamble, 1982). It stipulates the rights and obligations of states regarding the use of the ocean, its resources, and the protection of the marine and coastal environment. The Convention lays out, among other things, the system of maritime boundaries with the associated rights and obligations, and the rights of access for landlocked states to the sea. It also sets a unique governing regime for the Area, which along with its mineral resources are the 'common heritage of humankind'. Some of the most important principles under UNCLOS in this regard are that:

- no state can claim or exercise sovereignty or sovereign rights over any part of the Area or its resources;
- activities in the Area must be carried out for the benefit of humankind as a whole, irrespective of the geographical location of states, taking into particular consideration developing states' interests and needs;
- the Area and its resources are open to use exclusively for peaceful purposes by all states, whether coastal or landlocked, without discrimination; and
- financial and other economic benefits derived from activities in the Area must be equitably shared, on a non-discriminatory basis.

Broader principles relating to maritime zones and sovereign rights as well as those pertaining to the protection of the marine environment are discussed in more detail in this section.

3.1. Historical context

Until modern international law evolved, governance of the seas was based upon the concept of 'freedom of the seas' (Smith, 1977). This concept is generally regarded as the foundation of international legal doctrine for the seas (Prislan and Schrijver, 2009). A coastal state's sovereign rights were limited to a band of water extending from a nation's coastline, usually for 3 nautical miles (nm; 5.6 km; 3.5 miles). This concept is also known as the 'cannon shot' rule. All waters beyond national boundaries were considered international waters and thereby free to all nations but belonging to none (the *mare liberum* principle propounded by Hugo Grotius in 1609; translated in Grotius, 1916). In the 20th century, nations started to protect their national resources more assertively with, for example, the United States (U.S.) declaring control over the resources of their continental shelf in 1945 (Young, 1950) and Iceland unilaterally expanding its territorial limit from 4 nm to 12 nm in 1958 (Green, 1960). The latter resulted in the so-called 'cod wars' with the UK. Many countries followed suit in extending their territorial boundaries outwards, usually only to 12 nm (though with some notable exceptions), and claims of additional sovereign rights over fish and other natural resources extending outwards as far as 200 nm (Rothwell and Stephens, 2023, pp. 9–10).

Against the backdrop of these expanding claims to sovereign rights in the sea and ocean floor and a related concern for a 'deep-sea gold rush' for seabed mineral deposits located in areas beyond national jurisdiction, the famous speech by Arvid Pardo (noted above) was made before the UN General Assembly in 1967. In 1970, the same year as the first commercial test mining for polymetallic nodules was carried out in 800 m deep water on the Blake Plateau, off Florida (Jones et al., 2017), the UN recalled earlier resolutions on the seabed and the ocean floor beyond the limits of national jurisdiction and declared this area as the common heritage of mankind (1970 UNGA Resolution 2749 (XXV), paragraph 1). This development was instrumental in launching negotiations for the third Conference on the Law of the Sea (see below). The path was paved to develop an international regulatory framework to ensure, among other things, that mineral exploitation could be conducted in a 'fair', environmentally sensitive, and globally equitable way (Lusty et al., 2022). Being developed during the era of Cold War with its increasing militarisation of the sea, the Convention was also conceived as means by which to ensure greater security for the oceans and reinforce the peaceful uses of the sea (Booth, 1985; Rothwell and Stephens, 2023).

The multilateral negotiations which led up to the conclusion of UNCLOS were long and somewhat complex, beginning initially with the first Conference on the Law of the Sea in 1958 (UNCLOS I). This conference resulted in several treaties, each dealing with discrete maritime zones or regimes, but with a number of critical areas of disagreement still remaining – not least of which was the exact breadth of territorial waters possessed by coastal states and what rights, if any, pertained beyond the territorial

sea. An attempt to reach an answer to these questions in 1960 failed (in the UNCLOS II conference), and eventually a further, more ambitious conference was convened from 1973 onwards. In fact, the UNCLOS III negotiations went on for close to a decade, lasting from 1973 to 1982. Although the Convention was signed at this point (December 10, 1982, in Montego Bay, Jamaica), it did not enter into force for some time, due primarily to concerns over the operability of the seabed regime included in Part XI of the Convention and, in particular, increasing resistance, initially from the U.S. and subsequently from a broader group of Western states, to the principle of Common Heritage of Mankind as it was envisaged therein. With Guyana becoming the sixtieth state to ratify the Convention in November 1993, it soon became clear that UNCLOS would enter into force within 12 months (as per the terms of UNCLOS, Article 308) without the support of the majority of Western states. This precipitated an effort to make the workings of the deep-sea mining regime more palatable to many developed states, especially those in Western Europe and North America who were increasingly embracing more free market, liberal politics (Collins and French, 2020). The result of these efforts was the conclusion of an Implementing Agreement in 1994 (which entered into force in 1996) relating to the Implementation of Part XI of UNCLOS, the effect of which was essentially to water down some of the more contentious, egalitarian principles of Part XI (see also Section 5). The central impact of this agreement was to secure a broad enough consensus to allow for the establishment of the International Seabed Authority (ISA) as an autonomous organisation with exclusive competencies over mineral resources in the international seabed area.

As of September 2025, 171 parties have ratified the Convention, which include 170 states and the EU, 30 of these being landlocked. San Marino and Kyrgyzstan are the latest members to accede to UNCLOS, having ratified it in July 2024 and September 2025, respectively. Of the 171 parties having ratified the Convention, 154 also ratified the 1994 Agreement. A further 13 UN member states have signed, but not ratified the Convention. The U.S., although having supported the development of the Convention, did not sign it in objection to Part XI. They did, however, sign the 1994 Agreement, but did not ratify it.

UNCLOS is a framework convention and, at times, foregoes specific obligations or detailed prescriptions – including, for instance, those relating to management of activities in the Area – in favour of broader directives and delegation of further decision-making to states and international institutions (Lothian, 2023). In addition to reliance upon existing international institutions such as the International Maritime Organization, the Convention established three new intergovernmental organisations which were assigned specific tasks:

- the Commission on the Limits of the Continental Shelf (CLCS);
- the International Tribunal for the Law of the Sea (ITLOS); and
- the International Seabed Authority (ISA).

The role of the CLCS is to facilitate the implementation of the Convention in respect of the establishment of the outer limits of the continental shelf beyond 200 nm from the baseline from which the breadth of the territorial sea is measured. Although further discussion of the work of the CLCS goes beyond the remit of this article, a consequence of the slow and uncertain process of extended continental shelf delineation is that the precise extent of the Area (i.e., the residual part of the seabed left untouched by these claims) remains uncertain.

Responsibilities of ITLOS lie mainly in disputes over the interpretation or application of the Convention. Such disputes may concern the delimitation of maritime zones, navigation, conservation and management of the living resources of the sea, protection and preservation of the marine environment and marine scientific research. Although ITLOS is one amongst many judicial or arbitral forums through which states can resolve such disputes, the Tribunal does have some specific, special functions, and of central relevance to this article, it has a discrete Seabed Disputes Chamber. This Chamber not only has jurisdiction to issue advisory opinions on matters related to the legal governance of activities in the Area, it is somewhat unique amongst international courts in its ability to hear disputes not only between states and the ISA itself, but also with private entities (contractors) involved directly in relevant activities in the Area (Collins and French, 2020).

Lastly, but most relevant to this article, the ISA is tasked with the management of the mineral resources of the seabed while at the same time having to provide for the necessary measures to ensure the effective protection of the marine environment from harmful effects that may arise from activities in the Area (Section 5).

3.2. Maritime zones and sovereign rights

The Convention sets out the delineation of maritime zones, each with distinct legal rights and obligations for coastal states and other states in a particular zone (Tanaka, 2011). The zones cover the entirety of the world's oceans from a coastal state's baseline (i.e., its coastline, normally measured from the low water mark) to areas beyond national jurisdiction and are based primarily on geomorphological principles (see, for instance, Willaert, 2021). These zones include, among others, the *territorial sea*, the *exclusive economic zone*, the *continental shelf* and the *extended continental shelf*, the *high seas* and the *Area* (**Figure 1**), with varying degrees of sovereignty or sovereign rights over natural resources evident within each. The *territorial sea* extends up to 12 nm from the baseline. Within it, the coastal state exercises full sovereignty, including over the airspace above and the seabed and subsoil thereof (UNCLOS, Articles 2 and 3).

The *exclusive economic zone* stretches beyond and adjacent to the *territorial sea* up to 200 nm. Here, the coastal state has sovereign rights for exploring and exploiting natural resources of the waters superjacent to the seabed, and of the seabed and its subsoil (more precisely, the sub-seabed), while respecting the freedoms of navigation and overflight enjoyed by other states

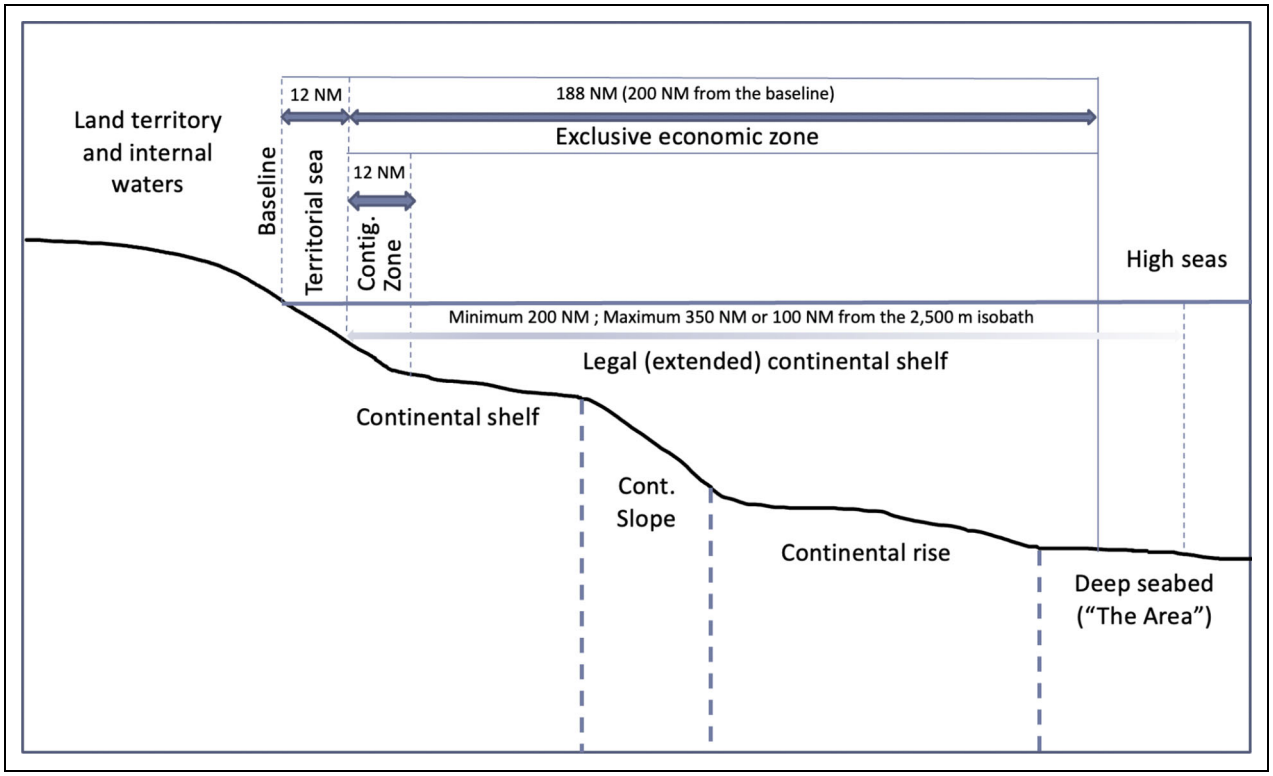

Figure 1. Maritime Zones according to the United Nations Convention on the Law of the Sea (UNCLOS). Limits of maritime zones are given in nautical miles (NM). Provided by R Collins.

(UNCLOS, Articles 55–58). A coastal state, however, must officially declare its sovereign rights in its exclusive economic zone.

The *continental shelf* is defined by the Convention as the seabed and subsoil beyond the *territorial sea* extending to 200 nm from the baseline (UNCLOS, Article 76). The coastal state has exclusive rights to exploit resources on and beneath the seabed, irrespective of occupation or proclamation, whereby natural resources comprise 'of all mineral and other non-living resources of the seabed and subsoil, together with living organisms belonging to sedentary species, which are either immobile or are unable to move except in constant physical contact with the seabed or subsoil (Article 77). The sovereign rights of the coastal state, however, do not affect the legal status of the overlying waters or of the airspace above these waters, and may not infringe upon or interfere with navigation or other rights and freedoms of other states including the laying or maintenance of submarine cables and pipelines (Articles 78 and 79).

In cases where the outer edge of the continental margin extends beyond 200 nm from the baseline, a state can claim an *extended continental shelf* up to either 350 nm from its baseline or a point not exceeding 100 nm from the 2,500 m isobath (UNCLOS, Article 76(5)), provided it remains a natural extension of its land territory. Such claims are significant due to the increasing demand for natural and mineral resources. The CLCS reviews these claims, though it does not resolve boundary disputes, which must be negotiated by the states involved.

3.2.1. Areas beyond national jurisdiction: The high seas and the Area

The high seas are open to all states which enjoy freedoms such as navigation, overflight, and laying of submarine cables (UNCLOS, Article 87). These freedoms are to be exercised by all states with due regard for the interests of other states in their exercise of these freedoms and, furthermore, with due regard for the rights under the Convention with respect to activities in the Area. In the same vein as agreed for the Antarctic continent in the Antarctic Treaty (1959), 'the high seas shall be reserved for peaceful purposes' and 'no State may validly purport to subject any part of the high seas to its sovereignty' (UNCLOS Articles 88 and 89).

In *areas beyond national jurisdiction* (ABNJ), the Convention distinguishes between 'the high seas' (UNCLOS Part VII) and 'the Area' (UNCLOS Part XI). The water column beyond national jurisdiction falls under the regime of the high seas, whereas the seabed and subsoil beyond the external limit of the continental shelf constitute the international seabed area and are generally called the Area. The high seas are defined by UNCLOS as all parts of the ocean that are not included in the exclusive economic zone, the territorial sea, or the internal waters of a country, or in the archipelagic waters of an archipelagic country (Article 86). The high seas and the Area are managed by different governance principles and different bodies (Mendenhall and Bateh, 2024). Activities in the high seas are governed either exclusively under the principle of flag state jurisdiction (UNCLOS, Article 92) or, to the extent that international law provides otherwise, are

subject to varying degrees of regulation by a variety of regional and sectoral organisations, for example, regional fisheries management organisations (RFMO) and regional sea conventions such as the Oslo-Paris Agreement on the Protection of the North-East Atlantic (OSPAR). Activities pertaining to the mineral resources of the seafloor in the Area are governed in their entirety by the ISA.

The Area is 'the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction' (UNCLOS, Article 1). Part XI and Annexes III and IV of UNCLOS provide the legal framework for the governance of the resources of the seabed in the Area. The mineral resources of the Area comprise 'all solid, liquid or gaseous mineral resources in situ … at or beneath the seabed, including polymetallic nodules'. When recovered from the Area, these resources are referred to as minerals (Article 133). 'Activities in the area' are all activities of exploration for, and exploitation of, the resources of the Area (Article 153). Crucially, the Area and its mineral resources are 'the common heritage of mankind' (Article 136), or as referred to nowadays, 'humankind'. Under the common heritage provision, no state can claim or exercise sovereignty or sovereign rights over any part of the Area or its resources (Article 137); activities in the Area must be carried out for the benefit of humankind as a whole, irrespective of the geographical location of states, taking into particular consideration developing states' interests and needs (Article 140); the Area and its resources are open to use exclusively for peaceful purposes by all states, whether coastal or landlocked, without discrimination (Article 141); and financial and other economic benefits derived from activities in the Area must be equitably shared, on a non-discriminatory basis.

According to the Convention, state parties to the Convention, state enterprises or natural or juridical persons 'who possess the nationality of States Parties or are effectively controlled by them or their nationals, when sponsored by such States' (Article 153) are legally entitled to carry out mining activities in the Area. Sponsoring in this context refers to a state having submitted a certificate of sponsorship for a contractor to the ISA and thus being the sponsoring state for this contractor. While some member states hold exploration licences through their national agencies (e.g., Germany through their Federal Institute for Geosciences and Natural Resources), other state parties sponsor private entities. The UK, for example, sponsors UK Seabed Resources Ltd (UKSRL), and Nauru sponsors Nauru Ocean Research Inc (NORI; TMC, 2024), a subsidiary of Canada-based TMC. The latest sponsoring state is Bahrain, which will sponsor U.S.-based company Impossible Metals (ISA, 2025c). The sponsoring state, as a subject of international law, is liable for internationally wrongful acts (Willaert, 2021). Although under international law a state will not be automatically responsible for the acts of private persons, if a contractor causes harm that the sponsoring state should have foreseen, then the state in question may be liable for a failure to exercise appropriate due diligence. The contractor is liable for the conduct of its activities, which is enforceable under the domestic laws of the sponsoring state (Seabed Disputes Chamber, Advisory Opinion; ITLOS, 2011). Hence, sponsoring states are under the obligation to implement national legislation ensuring their contractors' activities are carried out in conformity with Part XI of UNCLOS (Article 139). States holding a contract directly with the ISA (India, Poland and Russian Federation) also have national legislation in place or have announced that such legislation is forthcoming (Republic of Korea; Herh, 2025). The financial terms of applications for and issuing of exploration and exploitation licences are also laid out in UNCLOS (Annex III, Section 8).

4. Environmental protection under UNCLOS and the precautionary principle

The Convention gives the ISA the mandate to develop the necessary rules, regulations and procedures (RRPs) to ensure effective protection for the marine environment from harmful effects that may arise from activities in the Area (UNCLOS, Article 145), specifically:

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

This remit is strengthened by Part XII of the Convention which focusses on protection and preservation of the marine environment; Article 192 places an overriding obligation on all states to protect and preserve the marine environment and Article 194 urges all states to prevent, reduce and control pollution of the marine environment. With this remit, the ISA has been given 'a broad capacity to enact protective measures as it deems necessary' (Jaeckel, 2015).

The Convention does not contain a provision for the precautionary principle, but the idea of precaution has gradually been 'integrated' into it as well as other international treaties (Jaeckel, 2015). The precautionary principle or 'precautionary approach' has at its core the prevention of environmental harm by taking early action, that is, precautionary measures, even if scientific uncertainty about the risks remains. The terms 'precautionary principle' and 'precautionary approach' are often used interchangeably, although the latter is sometimes preferred as embodying less of a legal commitment. There seems to be no substantive difference, however, between commitments to apply either of them (Trouwborst, 2007); for this article, we use the term 'precautionary principle'. The aim of the precautionary principle is to enable decision-making in the face of lacking or insufficient evidence, existing uncertainty and incomplete information. It requires not only an assessment of the potentially harmful effects of an activity but also of the risks posed by incomplete information and uncertainty (Makgill et al., 2023).

The precautionary principle puts the onus on the actor to provide evidence that its actions and activities are safe. It was introduced into the broader corpus of international law through Principle 15 of the Rio Declaration on Environment and Development in 1992. In the context of ABNJ, it is first mentioned in 1995 in the UN Fish Stocks Agreement (Freestone, 2008). In 2011, the Seabed Disputes Chamber, through its interpretation of Part XI of the Convention and the Deep-Sea Mining regime, has ensured that the precautionary principle is embedded as an operative principle in the governance of the deep seabed (Kirkham et al., 2020). Furthermore, although not in the Convention explicitly, the precautionary principle is incorporated in the ISA's exploration regulations (albeit in the form of 'precautionary approach') according to which the ISA and the sponsoring state are required to apply it (e.g., ISBA/6/A/18 Regulation 31(2) for polymetallic nodules; see **Table 1** for coding explanation; ISA, 2000a).

In short, the Convention sets objectives for the protection of the marine environment in the Area rather than precise obligations, placing an obligation (in Article 197) on states to cooperate in formulating further rules, standards and guidelines in furthering this objective. This process is still on-going as we shall see below.

5. The mining regime in the Area

5.1. The International Seabed Authority

The ISA came into existence in 1994, though operating on a provisional basis only until its first Secretary-General was appointed in 1996, and is based in Kingston, Jamaica. Parties to UNCLOS are automatically member states of the ISA. Accordingly, as of September 2025, the ISA has 170 member states plus the EU. Non-member states, such as the U.S., can apply for observer status and thus participate in meetings, although are precluded from taking decisions.

The ISA is an autonomous institution with legal personality – that is, is the holder of rights and obligations – under international law (Collins and French, 2020). The ISA's purpose is rather ambitious; it is to govern the seabed mineral resources of the Area for the benefit of all (human)kind (Article 140) while at the same time ensuring the effective protection of the marine environment from harmful effects of mining activities in the Area (Article 145). To this end, the ISA's core competencies are (i) developing the seabed mining regime for the Area and adopting the regulatory framework, that is, the Mining Code, (ii) controlling access to the resources through a contractual system, and (iii) ensuring compliance with UNCLOS and the Mining Code. For its role in organising, controlling and carrying out activities in the Area (Articles 153 and 157), law-making powers have been bestowed on it (Article 176). The challenges faced by the ISA are not trivial: it has to manage an activity the impacts of which are as yet uncertain, on behalf of humankind over an area which covers approximately 54% of the global ocean (ISA, 2025f).

The ISA works through several organs, the main ones being the Assembly, the Council and the Secretariat. The Legal and Technical Commission (LTC), the Enterprise, the Finance Committee and the Economic Planning Commission are subsidiary organs. Not all organs are fully functioning yet (i.e., the Enterprise and the Economic Planning Commission), with the Secretariat being tasked with their functions until activities in the Area have reached a stage where the organs need to be fully functional (1994 Agreement, Annex, Section 1.3).

The *Assembly* is the supreme organ and the plenary body of the ISA with the power to establish general policies on any matters within ISA competence. It works in collaboration with the Council and approves regulations recommended by the Council as well as budgets (1994 Agreement, Annex, Section 3).

The *Council* is the executive organ of the ISA with critical decision-making functions and powers to establish more specific ISA policies (Collins and French, 2020). Aside from policymaking powers, the Council can exercise law-making and has supervisory competencies as well as the power to issue emergency orders. Its 36 members are elected by the Assembly on a 4-year rotation following a complex system to ensure equitable representation of major interests and geographical distribution (UNCLOS, Article 161; further explained below). Participation in the Council is open to every member state and observer. Unless elected, however, they do not have the right to vote. Notwithstanding this restriction, Council meetings are generally attended by more than the 36 official members, reflecting the importance of the Council as the decision-making organ.

Council members are drawn from four interest groups consisting of major consumers (4 seats); major investors (4 seats); major exporters (4 seats); and developing states and special interests (6 seats). A fifth group consists of members selected on grounds of equitable geographic representation (18 seats). For voting, the groups form four chambers, which ensures that no interest group can exert undue force to push through proposals aligned solely with their own interests. Functions of the Council include approval of recommendations by the Legal and Technical Commission for approval of a Plan of Work (PoW) for both exploration and exploitation activities, exercising control over activities in the Area, adoption and provisional application of the RRPs by which the ISA controls mining activities in the Area, as well as the issuing of emergency orders to prevent environmental harm. Once exploitation commences, the Council will assume further responsibilities such as issuing directives to the Enterprise, actions to protect land-based mineral producers in developing countries from adverse economic effect of mineral production in the Area (including in the form of compensation) and establishing mechanisms to ensure compliance with the ISA's regulations and contracts. Overall, the Council can be regarded as the main decision-making organ of the ISA, but, as we shall see, its powers regarding approval or disapproval of a PoW against the LTC's recommendation are somewhat limited (Rothwell and Stevens, 2023).

Table 1. Regulations for the exploration and exploitation of polymetallic nodules (PMN), polymetallic sulphides (PMS) and cobalt-rich ferromanganese crusts (CRC) in the Area as part of the International Seabed Authority (ISA) Mining Code

Mineral type	Regulations	Year adopted	Link[a]
PMN	ISBA/19/C/17[b]: Decision of the Council of the ISA relating to amendments to the Regulations on Prospecting and Exploration for PMN in the Area and related matters	2013	https://www.isa.org.jm/wp-content/uploads/2022/04/isba-19c-17_0-2.pdf
PMN	ISBA/21/C/19: Decision of the Council of the ISA relating to amendments to the Regulations on Prospecting and Exploration for PMN in the Area and related matters	2015	https://www.isa.org.jm/wp-content/uploads/2022/04/isba-21c-19_6.pdf
PMS	ISBA/16/A/12/Rev.1: Decision of the Assembly of the ISA relating to the regulations on prospecting and exploration for PMS in the Area	2010	https://www.isa.org.jm/wp-content/uploads/2022/04/isba-16a-12rev1_0.pdf
CRC	ISBA/18/A/11: Decision of the Assembly of the ISA relating to the Regulations on Prospecting and Exploration for CRC in the Area	2012	https://www.isa.org.jm/wp-content/uploads/2022/04/isba-18a-11_0.pdf
All	ISBA/19/A/12: Decision of the Assembly of the ISA concerning overhead charges for the administration and supervision of exploration contract	2013	https://www.isa.org.jm/wp-content/uploads/2022/04/isba-19a-12_0.pdf
All	ISBA/25/C/WP.1: Draft regulations on exploitation of mineral resources in the Area	2019[c]	https://www.isa.org.jm/wp-content/uploads/2022/06/isba_25_c_wp1-e_0.pdf
All	ISBA/29/C/ CRP.1: Draft regulations on exploitation of Mineral resources in the Area – Consolidated text	2024[c]	https://www.isa.org.jm/wp-content/uploads/2024/02/Consolidated_text.pdf
All	ISBA/30/C/CRP.1: Draft regulations on exploitation of Mineral resources in the Area – Revised Consolidated Text	Released Nov 29, 2024[d]	https://www.isa.org.jm/wp-content/uploads/2025/01/10012025-Revised-Consolidated-Text-2.pdf

[a]Accessed October 3, 2024.

[b]Part of the unique identification code for official documents issued by the ISA for ISA negotiations following UN practice. Coding denotes organisation/session/organ/document number; for instance, ISBA/19/C/17 indicates International Seabed Authority at the 19th Council session, 17th document of the session. A indicates Assembly; Rev, revision; and CRP, Conference Room Paper.

[c]Superseded.

[d]First reading completed by the Council at the 30th ISA meeting (March and July 2025). An updated, revised consolidated text will be prepared by the ISA Secretariat in advance of the first part of the 31st session in 2026, for the Council's consideration (Eni-ibukun et al., 2025).

The Council is assisted by the *Legal and Technical Commission* (LTC), an advisory subsidiary body that provides recommendations to the Council on matters within its scope. The LTC comprises, at present, 41 independent members (geological, legal, economic, and environmental experts), proposed by member states and elected by the Council for a period of 5 years (ISA, 2024c). The role of the LTC is to ensure that decisions of the ISA are based on sound scientific and technical expertise. Its functions include drafting exploration and exploitation regulations, standards and guidelines (S&Gs) for consideration by the Council, as well as assessing applications for a PoW for exploration and exploitation contracts and the mandatory environmental impact statement as part of them. The application documents are confidential; not even Council members have access to them (Jaeckel et al., 2023). Notwithstanding that the Council makes the final decision on an application for a PoW; its decision is based on the LTC's recommendation. Thus, although the LTC has no formal decision-making powers, through its recommendations, at least when it comes to applications for PoWs, it can exert decisive powers (Jaeckel, 2015).

While Council and Assembly meetings can be followed online (ISA web TV, accessible at https://www.isa.org.jm/isa-web-tv/), the LTC generally meets behind closed doors, that is, without members or observers being present (ISBA/6/C/9 Rule 6; ISA, 2000b). This rule has given cause for criticising the ISA as not being transparent in its decision-making and thus not following the 1998 Aarhus Convention (United Nations, 1998) on public participation (e.g., Ardron et al., 2023). Not only does the process of consideration of applications for a PoW by the LTC happen behind closed doors, but the way the Council then decides on the LTC's recommendation seems to 'promote' the

development of the industry by streamlining the process (Rothwell and Stephens, 2023). Upon consideration by the LTC of whether an application for a PoW fulfils the necessary criteria for approval, the LTC recommends to the Council to approve the application by a simple majority. This approach, however, is rather unusual considering that decision-making by the ISA organs should be 'as a general rule . . . by consensus' (1994 Agreement, Annex, Section 3, paragraph 2). For the Council to disapprove the LTC's recommendation requires a higher level of agreement across the Council's four voting chambers than to approve such recommendation; a two-third majority of Council members present and voting, including a majority of members present and voting in each of the special interest chambers, is needed for such disapproval. Should the Council not arrive at a decision on the LTC's recommendation to approve an application for a PoW within 60 days, the recommendation is deemed to have been approved by the Council (1994 Agreement, Annex, Section 3, paragraph 11(a)).

The *Secretariat* is the administrative organ of the ISA and is led by the Secretary-General who administers, with the help of nearly 50 staff members, the day-to-day functions of the ISA pursuant to the instructions from the Council or Assembly (UNCLOS, Article 166). Aside from providing general administrative support and organising the annual sessions, workshops and technical meetings, the Secretariat administers exploration and exploitation contracts, provides background papers and commissions expert reports.

The *Finance Committee* advises the Council and Assembly on financial and budgetary matters (1994 Agreement, annex, Section 9.7) as well as develops the 'draft financial rules, regulations and procedures' (UNCLOS, Article 162). Its 15 members are financial experts elected by the Assembly for 5 years and include at least one member from each of the aforementioned four Council groups. The Financial Committee oversees the financial management of the ISA and makes recommendations on financial decisions to the Council and Assembly.

The *Enterprise* is mandated to carry out activities in the Area and thereby is the commercial arm of the ISA (UNCLOS, Articles 153 and 170). The Enterprise is autonomous in the conduct of its operations and will be directed by a Director General and a Governing Board, both elected by the Assembly. As no commercial mining is taking place in the Area at present, the Enterprise is not operational yet and its interim functions are carried out by the Secretariat. These functions include monitoring and reviewing trends and developments in deep-sea mining and the world metal markets, and assessment of scientific research, especially related to the impacts of activities in the Area. Once functional, the Enterprise will become an organ of the ISA. The first report of the Enterprise was presented by its Interim Director General to the Assembly in July 2024. The Economic Planning Commission, another advisory body, is also not operational yet, with the LTC being assigned its functions in the interim (1994 Agreement, annex, Section 1(4)). Once functional, the Commission's functions include reviewing economic trends relevant to seabed minerals and assisting developing states that are producers of minerals and that are affected seriously by the production of minerals from the Area (Article 164).

The *Economic Planning Commission*, its operationalisation only having been decided at the 30th ISA meeting (July 2025), is tasked with advising the Council on economic aspects of deep-sea mining. It is essential for equitable benefit-sharing (Eni-ibukun et al., 2025).

The particular setup of the ISA and its decision-making processes are to ensure that no one political interest or understanding of the common heritage of humankind can overrule any other(s) in this process (Collins and French, 2020). This setup makes decision-making complex and sometimes longwinded. For instance, it took 12 years from the first formal request for drafting regulations for the exploration of polymetallic sulphides by Russia in 1998 (ISBA/4/A/18; ISA, 1998) and several draft revisions until such regulations were finally adopted in 2010 (ISA, 2010). For adoption of new regulations, the Council must reach consensus, that is, without formal objections raised by a Council member. Though UNCLOS provides for a conciliation committee (Article 161), the objections of a single member can in principle veto the adoption of a new regulation. Once adopted, regulations apply provisionally, although they still need the Assembly's final approval (Article 160). The Assembly can refer any matter back to the Council should it require changes. Unlike the Council, the Assembly, if a consensus cannot be reached, can adopt regulations with a two-thirds majority (Article 159).

The ISA is also given the competency for monitoring, control and enforcement of compliance with provisions made in UNCLOS as well as its own rules and regulations (UNCLOS, Article 153(4)). To this end, it is empowered to take necessary measures in order to secure compliance and control of activities, including powers of inspection of any installations engaged in activities in the Area (Article 153(5)). The Authority's mandate in this regard is backed up with specific power to sanction non-compliance and, in particular, impose monetary penalties (Annex III, Article 18). How this power will be implemented in practice, especially inspections of installations, is still being negotiated at the ISA.

In summary, the main competencies of the ISA are (i) developing and adopting the Mining Code; (ii) issuing of exploration and exploitation contracts; and (iii) monitoring and enforcing compliance with the Mining Code and UNCLOS, while at the same time protecting the environment from harmful effects of deep-sea mining activities in the Area.

5.2. The Mining Code

The Mining Code is the set of rules and regulations that manage and control mining activities in the Area. Its overarching framework is provided by UNCLOS and specifically elaborated in the 1994 Implementation Agreement (Annex, Section 1(5)). The code sets out the legal responsibilities of contractors who hold exploration and exploitation contracts with the ISA, states sponsoring these contracts, and the ISA itself. It consists of the binding regulations and standards as well as the non-binding guidance documents which are recommendatory (for an

Table 2. Guidelines for the exploration and exploitation of mineral resources in the Area as part of the International Seabed Authority Mining Code[a]

Mineral type	Document[b]	Year adopted	Link[c]
All	ISBA/29/LTC/7: Recommendations for the guidance of contractors in the preparation of a five-year periodic review report for exploration contracts	2024	https://www.isa.org.jm/wp-content/uploads/2024/07/2412886E.pdf
All	ISBA/25/LTC/6/Rev.3: Recommendations for the guidance of contractors for the assessment of the possible environmental impacts arising from exploration for marine minerals in the Area	2019, revised 2022 and 2023	https://www.isa.org.jm/wp-content/uploads/2023/08/2315256E.pdf
All	ISBA/19/LTC/14/Rev.1: Recommendations for the guidance of contractors and sponsoring States relating to training programmes under plans of work for exploration	2013, revised 2024	https://www.isa.org.jm/wp-content/uploads/2024/04/2405316E.pdf
All	ISBA/21/LTC/15 and ISBA/21/LTC/15/Corr.1: Recommendations for the guidance of contractors on the content, format and structure of annual reports	2015, corrected 2021	https://www.isa.org.jm/wp-content/uploads/2023/05/ISBA-21-LTC-15-e.pdf
All	ISBA/21/LTC/11: Recommendations for the guidance of contractors for the reporting of actual and direct exploration expenditure	2015	https://www.isa.org.jm/wp-content/uploads/2022/04/isba-21ltc-11-EN-1.pdf
PMS and CRC	ISBA/25/LTC/8: Recommendations for the guidance of contractors on the relinquishment of areas under the exploration contracts for polymetallic sulphides or cobalt-rich ferromanganese crusts	2019	https://www.isa.org.jm/wp-content/uploads/2022/04/isba_25_ltc_8-e.pdf

[a]There are no standards for exploration; standards for exploitation activities are in draft form as of September 2025.

[b]Coding denotes organisation/session/organ/document number; for instance, ISBA/25/LTC/6/Rev.3 indicates International Seabed Authority at the 25th Legal and Technical Commission session 6th document of this session Revision 3.

[c]Accessed October 3, 2024.

overview, see **Tables 1** and **2**). While regulations, once adopted, are difficult to amend, standards and guidance documents provide the necessary flexibility to be responsive to changing circumstances, for example, a growing body of knowledge (Singh et al., 2025). They can be regularly reviewed and, if required, updated according to the latest scientific evidence (Singh, 2021), thus 'future proofing' the Mining Code. The development of the Mining Code follows a 'building block' approach with S&Gs developed in phases accorded to level of necessity, namely (i) those deemed necessary by the time of the adoption of the regulations; (ii) those necessary before the receipt of an application for a Plan of Work for approval; and (iii) those that need to be in place before commercial production commences (ISBA/25/C/19/Add.1; ISA, 2019b). All S&Gs essential to give effect to the exploitation regulations must be completed and adopted before or together with the regulations (ISBA/25/C/37; ISA, 2019c).

Contractors have exclusive rights for exploration in their contract area for an initial period of 15 years with the possibility to extend the contract multiple times (UNCLOS, Annex III, Articles 7 and 16). The size of the area assigned to each contract varies with the mineral resource type and whether the contract is for exploration or exploitation. During the time of exploration, the contractor is obliged to return parts of its assigned contract area to the ISA, resulting in the exploitation area being a fraction of the initially allocated area (Willaert, 2021). For the exploration of polymetallic nodules, the initially allocated areas can be up to 150,000 km^2. Over a period of 8 years, the contractor must relinquish 50% of the initial contract area in three portions (ISBA/19/C/17, Regulation 25; **Table 1**) resulting in a final contract area for exploitation of 75,000 km^2. Contract areas for polymetallic sulphides and cobalt-rich crusts are considerably smaller than those for nodules. For the exploration of polymetallic sulphides, initial contract areas are 10,000 km^2 consisting of 100 blocks, each block no greater than 100 km^2. After relinquishment to the Authority, the remaining area for exploitation cannot exceed 2,500 km^2 (ISBA/16/A/12/Rev.1; **Table 1**). For cobalt-rich crusts, the allocated exploration area is 3,000 km^2 consisting of 150 blocks of no greater than 20 km^2 each, with the area remaining following relinquishment being no greater than 1,000 km^2.

Reserved areas are held in a 'site bank' which is reserved for access by the Enterprise or by developing countries (UNCLOS, Article 170, Annex IV and 1994 Agreement, Annex, Section 2). This system of 'reserved areas' is to ensure that developing states, optionally in cooperation with the Enterprise, can engage in mining activities in the Area. Eight developing countries are sponsoring states under this system and have signed exploration contracts with the ISA (Tonga, Nauru, Kiribati, Singapore, the Cook Islands, China and Jamaica; ISA, 2024b). As Willaert (2021) points out, this

arrangement is not without problems. For instance, a deep-sea mining contractor of a developed state could establish a subsidiary company in a developing state and, thus, through the sponsorship of the developing state, apply for an exploration contract. This possibility could lead to forum-shopping by companies for developing states and thereby undermine the principle of common heritage of humankind.

5.3. Requirements for a Plan of Work for exploration activities in the Area

Exploration regulations and recommendations exist for each of the three main mineral resources and are shown in **Tables 1** and **2**. The requirements for, and process of, obtaining a contract for exploration are set out in these rules. In order to apply for a contract for exploration of polymetallic nodules, a PoW must be submitted to the ISA containing the following information (ISBA/6/A/18; ISA, 2000):

- sufficient information of the financial and technical capabilities of the applicant to carry out the proposed PoW and fulfil its financial obligation to the ISA (Regulation 12);
- sufficient data and information with respect to the area under application to enable the Council to designate a reserved area (Regulations 15 and 16);
- a general description and a schedule of the proposed exploration programme including the programme of activities for the next 5 years (Regulation 18(a));
- description of the programme for oceanographic and environmental baseline studies as per the Mining Code that would enable an assessment of potential environmental impacts of the proposed exploration activities (Regulation 18(b));
- a preliminary environmental impact assessment (EIA; Regulation 18(c)); and
- a description of the proposed measures for the prevention, reduction and control of pollution and other hazards, as well as possible impacts of the proposed exploration activities (Regulation 18(d)).

The PoW is assessed by the LTC following provision in the exploration regulations (e.g., ISBA/19/C/17, Regulations 21 and 31; **Table 1**). The PoW must demonstrate, for instance, the effective protection of human health and safety and that installations do not interfere with international shipping lanes or with fishing activities in areas of intense fishing activity. Furthermore, the LTC has to determine whether any proposed activities would have serious harmful effects on vulnerable marine ecosystems (e.g., ISBA/19/C/17, Regulation 31, paragraph 4; **Table 1**). If so, the LTC has the role to ensure that the activities are managed to prevent such effects or are not authorised to proceed. The problem lies (and we will return to it) in defining serious harm and at which point impacts turn from being harmful to causing serious harm. As mentioned before, the Council decides, based on the LTC's recommendations, whether to approve the application and, if so, that a contract can be issued to the contractor.

Contractors are required to take the necessary measures to prevent, reduce and control pollution and other hazards to the marine environment arising from their activities in the Area and to apply a precautionary approach and best environmental practices (for nodules: ISBA/19/C/17, Regulation 31). As part of this obligation, they must implement monitoring programmes to assess the environmental impacts of their activities and report to the ISA on the implementation and results of the monitoring programme annually. For the assessment of likely effects of planned exploration activities, contractors are required to gather baseline data and establish environmental baselines following the appropriate ISA recommendations (**Tables 1** and **2**). Finally, prior to exploration commencing, contractors must submit a contingency plan to the ISA outlining an effective response plan to incidents likely to cause serious harm or a threat of serious harm to the marine environment arising from their activities. Should such an incident occur, the ISA can take emergency measures to 'prevent, contain and minimize serious harm or the threat thereof to the marine environment'. The annexes of the respective exploration regulations provide templates for the notification of intention to engage in prospecting and for the application for approval of a PoW for exploration. After completion of exploration, contractors have continued responsibility for any damage arising from their exploration activities (e.g., ISBA/19/C/17, Regulation 30; **Table 1**). Contractors are obliged to submit all data of their exploration work including environmental baseline and monitoring data, report annually, and submit 5-year periodic review reports to the Authority. They must also provide practical training for ISA personnel and developing States (ISBA/19/C/17; **Table 1**).

5.4. Minimum requirements for a Plan of Work for exploitation activities in the Area

Details of requirements for an application for the approval of a PoW for exploitation are still being discussed as part of the negotiations on the exploitation regulations. Draft regulations 7, 14–16, 57–58 and 86 of the Revised Consolidated text (ISBA/30/C/CRP.1; **Table 1**; ISA, 2024a) pertain to the different aspects of a PoW including modalities, and Annex I provides a template for an application for approval of a PoW. Although not agreed yet, the components listed in Annexes II–VIII should be seen as minimum requirements for an application. These include a Mining Workplan, a Financing Plan, a Scoping Report, an Environmental Impact Statement (EIS), a Health and Safety as well as a Maritime Security Plan, an Environmental Management and Monitoring Plan (EMMP), a Closure Plan, and possibly a test mining report which is still in discussion at the Council. Requirements for environmental management and monitoring are addressed in Part II, Section 3 of the draft regulations and require further discussion, as is pointed out in the comment to this section in the Revised consolidated text. Contractors shall monitor and manage the environmental impacts of their activities on the marine environment with the aim to assessing and demonstrating compliance with the EIS, EMMP and the Closure Plan. Further details are provided in Annex VII of the draft regulations.

As part of a PoW, contractors must provide details of proposed Preservation Reference Zones (PRZ) and Impact Reference Zones (IRZ; draft Regulation 13, paragraph 9(v)).

Both types of zones are designated within the contract area and are to be representative of the environmental characteristics of the contract area as well as of each other. The zones will be used to assess the effects of exploitation activities on the marine environment including by way of comparison between them. While IRZs are predicted to be impacted by exploitation activities, PRZs are predicted not to be impacted. Details to be provided by the applicant include the locations, implementation and the planned management and monitoring of the zones, with further details still having to be agreed. These are likely to be included in accompanying S&G documents which exist either in draft form or still need to be developed (see **Table 3**).

6. State of play by September 2025

6.1. Exploration in the Area

As of September 2025, the ISA has issued 31 exploration contracts to 22 legal entities in the Area (ISA, 2025d). These are, namely, 19 contracts for exploration of polymetallic nodules (mainly in the Clarion-Clipperton Zone, but also the Indian Ocean and Western Pacific Ocean); eight for polymetallic sulphides (Southwest Indian Ridge, Mid-Atlantic Ridge, Central Indian Ridge, Central Indian Ocean); and four for cobalt-rich ferromanganese crusts (Western Pacific, Magellan Mountains Pacific). Contractors have exclusive rights to explore minerals for an initial period of 15 years in their contract area with the possibility to extend the contract multiple times (UNCLOS, Annex III, Articles 7 and 16).

6.2. Development of exploitation regulations for the Area

The development of exploitation regulations started in 2011 (Blanchard et al., 2023), but the LTC took until 2019 to present the first recommendations for draft regulations to the Council (ISBA/25/C/WP.1; ISA, 2019d). Negotiations of the draft took a setback during the Covid pandemic, and the 26th ISA meeting convened over 2 years in 2020 and 2021. In June 2021, the Republic of Nauru notified the ISA of the intent of its sponsored contractor, NORI, to apply for an exploitation contract for its contract area in the CCZ within 2 years (Singh, 2021; 2022). This notification triggered the so-called 'two-year rule' (1994 Agreement, Section 1(15)(c)) according to which, if the ISA fails to finalise the exploitation regulations within 2 years of this rule being triggered, the ISA will have to consider applications for the approval of a PoW for exploitation notwithstanding the absence of such regulations. The Council, in anticipation that the exploitation regulations would not be finalised by the so-called 'deadline', confirmed in March 2023 its position that commercial exploitation of mineral resources in the Area should not be carried out in absence of RRPs (ISBA/28/C/9, preambular paragraph 3; ISA, 2023a). Thus, the 'two-year deadline' passed in July 2023 without the regulations having been adopted and without a PoW for exploitation having been submitted, but the pace of negotiations has increased noticeably since then.

In February 2024, the 2019 draft exploitation regulations were replaced by the so-called 'Consolidated text' (ISBA/29/C/CRP.1; **Table 1**), the reading of which the Council completed at the July 2024 meeting. A revised consolidated text (ISBA/30/C/CRP.1; **Table 1**), that is, a harmonised and streamlined text based on agreements and discussions held up to then, was published in November 2024 (ISA, 2024a), with a view to adopting the exploitation regulations at the 30th ISA meeting in 2025 (ISBA/29/C/9/Add.1; ISA, 2024d). The reading of the consolidated text was completed in July 2025, but – as could be expected due to the high number of still unresolved issues – the 30th ISA meeting closed without reaching a consensus for adoption of the regulations. In preparation for the 31st ISA meeting in 2026, intersessional work will continue, and the Secretariat will prepare a further revised consolidated text to be published ahead of the March 2026 Council meeting to serve as a basis for further discussions (Eni-ibukun et al., 2025).

In April 2025, the White House released an executive order by the U.S. President, authorising the U.S. to issue seabed mineral exploration licences and commercial recovery permits in the Area (Executive Order 14285; USA, 2025). This unilateral action drew strong criticism from the ISA's Secretary-General and several ISA delegations as undermining the fundamental principles of international law, and especially of UNCLOS, that have guided deep-sea governance for decades. However, the U.S. has not ratified UNCLOS and therefore is not legally bound by it. Disregarding the controversy around the U.S.'s action, it does highlight the rise in geopolitical tension to secure access to critical strategic minerals. The first submission for an application for a commercial recovery permit in the CCZ under U.S. law followed within days of the release of the executive order by a subsidiary of TMC with TMC targeting the start of commercial nodule mining in Quarter 4 of 2027 (TMC, 2025).

Nauru's announcement in November 2024 for its sponsored contractor, NORI, to submit an application for a PoW for exploitation to the Authority in June 2025 (Republic of Nauru, 2024) was not followed through. It is not clear when to expect the first submission of such an application for the Area. Negotiations on the exploitation regulations will resume in 2026 based on a further revised draft to be published in preparation for the 31st ISA meeting. Considering the number of unresolved issues, it remains to be seen whether the necessary consensus for adoption of the exploitation regulations will be found in 2026.

7. Unresolved issues

The ISA's indicative roadmap from July 2023 (ISBA/28/C/24; ISA, 2023b) and updated in July 2024 (ISBA/29/C/9/Add.1; ISA, 2024e), proposed the signing of the exploitation regulations at its 30th meeting in July 2025 – 'in the event that they are ready for adoption' – but as expounded in the previous section, this signing did not occur. Pickens et al. (2024) identified over 30 major regulatory issues still to be resolved, among them effective control (addressing the relationship between a sponsoring state and a non-state contractor); equalisation measures (to ensure level-playing fields with land-based mining and between contractors); provisions related to inspection, compliance, and enforcement; rights and interests of

Table 3. Standards and guidance documents proposed in July 2023 for the development and/or adoption as part of the International Seabed Authority (ISA) Mining Code by the facilitator for the Informal Working Group on the Protection and Preservation of the Marine Environment (ISBA/28/C/IWG/ENV/CPR.5; ISA, 2023d)

Document to be adopted as part of the ISA Mining Code	Type	Status	Link[a]
Standard on Environmental Impact Assessment process	Standard	Draft	https://www.isa.org.jm/wp-content/uploads/2022/12/Standard_and_Guidelines_for_environmental_impact_assessment-rev1.pdf
Guideline on Environmental Impact Assessment process	Guidance	Draft	https://www.isa.org.jm/wp-content/uploads/2022/12/Standard_and_Guidelines_for_environmental_impact_assessment-rev1.pdf
Standard on Preparation of Environmental Impact Assessment	Standard	To be developed	—
Guideline on Preparation of Environmental Impact Assessment	Guidance	Draft	https://www.isa.org.jm/wp-content/uploads/2022/12/preparation_of_an_environmental_impact_statement.pdf
Standard on Development and application of Environmental Management Systems	Standard	Draft	https://www.isa.org.jm/wp-content/uploads/2022/12/Environmental-Management-Systems-standard-and-guideline-_final.pdf
Guideline on Development and application of Environmental Management Systems	Guidance	Draft	
Standard on Preparation of Environmental Management and Monitoring Plans	Standard	To be developed	https://www.isa.org.jm/wp-content/uploads/2022/12/Environmental-Management-Systems-standard-and-guideline-_final.pdf
Guideline on Preparation of Environmental Management and Monitoring Plans	Guidance	Draft	https://www.isa.org.jm/wp-content/uploads/2022/12/environmental_management_monitoring_plans.pdf
Standard on Tools and Techniques for Hazard Identification and Risk Assessments	Standard	To be developed	—
Guideline on Tools and Techniques for Hazard Identification and Risk Assessments	Guidance	Draft	https://www.isa.org.jm/wp-content/uploads/2022/12/tools_and_techniques_for_hazard_identification_and_risk_assessments.pdf
Standard on the development of baseline environmental data	Standard	To be developed	—
Guideline on the development of baseline environmental data	Guidance	Draft	https://www.isa.org.jm/wp-content/uploads/2022/12/expected_scope_and_standard_of_baseline_data_collection.pdf
Standard on the form and calculation of an Environmental Performance Guarantee	Standard	Draft	https://www.isa.org.jm/wp-content/uploads/2022/12/Environmental-Performance-Guarantee-Final.pdf
Guideline on the form and calculation of an Environmental Performance Guarantee	Guidance	Draft	
Standard on preparation and assessment of an application for the approval of a Plan of Work for Exploitation	Standard	To be developed	—
Guideline on preparation and assessment of an application for the approval of a Plan of Work for Exploitation	Guidance	Draft	https://www.isa.org.jm/wp-content/uploads/2022/06/Plan-of-Work-SG_for-consultations.pdf
Standard on Environmental Threshold values	Standard	To be developed	—
Guideline on Environmental Threshold values	Guidance	To be developed	—

[a]Accessed February 21, 2025.

coastal states; financial mechanism and benefit-sharing provisions; provisions on liability; institutional arrangements, including the operationalisation of the Economic Planning Commission; and coordination with other existing international frameworks and initiatives on ocean governance, as well as novel concepts, such as intangible underwater cultural heritage (see also Tsioumanis et al., 2024). Of particular relevance to this article, and discussed further below, is the issue of developing environmental management thresholds which are a requirement for the successful implementation of EMMPs. This aspect together with those already mentioned require further discussion by the Council meeting in 2026. On environmental matters, unresolved issues include ensuring the effective protection and preservation of the marine environment, EIS, marine monitoring, as well as test mining. At the 28th ISA meeting (November 2023), the facilitator for the informal working group on the protection and preservation of the marine environment had already presented a list of proposed S&G documents on environmental matters to be required for the completion of the Mining Code. These include essential standards such as on the preparation of EIAs and on the preparation and application of EMMPs, with another 16 documents proposed (ISBA/28/C/IWG/ENV/CPR.5; **Table 3**; ISA, 2023c). Once the exploitation regulations are finalised, those S&Gs already drafted will likely need not only to be revised in light of changes in the regulations but also to be discussed and agreed upon. Altogether, 46 standard and/or guidance documents might be required for the completion of the Mining Code according to an updated list based on references in the Revised Consolidated text (ISBA/30/C/CRP.5; ISA, 2025e).

7.1. Serious harm and the development of environmental thresholds

One of the outstanding tasks to be completed before exploitation regulations can be agreed is the development of management thresholds. Such thresholds are instrumental in environmental management, the application of the precautionary principle and, hence, the avoidance of serious harm. Thresholds provide limits that, when reached, suggest a risk might become harmful or unsafe and thus provide an early warning of when effects on the environment might become harmful and/or consist of serious harm (Hitchin et al., 2023).

In 2022, the Council, having realised the need to develop such thresholds, tasked the LTC to set up intersessional expert groups to start developing thresholds on (i) toxicity, (ii) sedimentation/turbidity and (iii) noise and light in the water column (ISBA/27/C/42; ISA, 2022). The results and recommendations of the groups, in the first instance for the exploitation of polymetallic nodules, are expected to be released for stakeholder consultations during 2025 and, upon review by the Commission, reported to the Council (ISBA/30/C/4/Add.1; ISA, 2025a). Agreed thresholds will be legally binding and established through the standards. Whether arriving at thresholds on impacts of mining activities is at all possible with the existing knowledge is somewhat contentious (e.g., Amon et al., 2022a). It is clear, however, that the development of fair and effective thresholds will require wide-ranging acceptance from scientific, legal, management and political perspectives (Hitchin et al., 2023) – a challenging task to achieve for the ISA.

Pivotal for developing such thresholds is not only a thorough understanding of the unimpacted state of an ecosystem and the natural range or variability of its biotic and abiotic components, but also an understanding of the level of impacts at which harmful effects occur and at what level harmful effects turn into serious harm. This level of understanding, in turn, requires a definition of what constitutes 'serious harm' in the context of deep-sea mining. The ISA defines serious harm 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 RRPs adopted by the Authority on the basis of internationally recognized standards and practices' (e.g., ISBA/19/C/17; Regulation 1; **Table 1**). This definition might suffice for the purpose of international law, but in its practical application, what constitutes 'significant adverse change' is less clear; that is, whether 'significant' is to be understood as statistical significance and at what level of impact or effect such changes indicate a progression from being harmful to causing serious harm (Lusty et al., 2022). This ambiguity is not trivial, especially not for environmental managers, as the risk of harm should trigger preventative and precautionary actions, and almost all activities pertaining to deep-sea mining have been identified as likely to cause harmful effects or serious harm to the environment (Levin et al., 2016). A thorough understanding of what may or may not constitute significant change in, for example, biodiversity, ecosystem structure and function and other environmental variables is thus required to develop the management thresholds.

Levin et al. (2016) suggested using the concept of 'significant adverse impact' as a first step to define 'serious harm'. The concept was developed by the Food and Agriculture Organization (FAO) for the management of deep-sea bottom fishing on the high seas (FAO, 2009) and defines significant adverse impacts as 'those that compromise ecosystem integrity (i.e., ecosystem structure and function) in a manner that: (i) impairs the ability of affected populations to replace themselves; (ii) degrades the long-term natural productivity of habitats; or (iii) causes, on more than a temporary basis, significant loss of species richness, habitat or community types'. This concept has been incorporated and extended in an alternative definition of serious harm in the ISA's Revised Consolidated text (ISBA/30/C/CRP.1, Schedule; ISA, 2024a). This alternative definition incorporates the whole water column from seabed to the sea surface and includes effects that prevent natural recovery 'within a reasonable period' and cause long-term loss of genetic connectivity, as well as criteria for serious harm contained in Regional Environmental Management Plans. Leduc et al. (2024) proposed an operational framework based on Mengerink's (2018) definition of serious harm being 'a type of harmful effect that is substantial enough to require action to prohibit such impacts'. Determination of the level of harm that would be 'acceptable' will likely be based on ecological and economic considerations and values. The authors propose

a traffic light system, with a threshold level indicating a change from detectable (green) to significant harm (orange), and a further limit indicating a change from significant to serious harm (red). Activities in the orange sector would require additional management (avoid, minimise impacts); crossing into the red sector would require stopping mining operations. Definitions of significant and serious harm will vary with environmental conditions and the resource to be mined and thus will have to be determined for each licence area. The proposed framework would provide a standardised and adaptable way forward for the management of deep-sea minerals being based on a definition of serious harm that can be operationalised for the management of deep-sea mining.

As is evident from the above, sufficient and scientifically robust baseline data are crucial for the necessary understanding of deep-sea ecosystems and are the foundation on which the ISA will have to decide on any exploitation activities going forward. The draft regulations call repeatedly for 'best available scientific information' (e.g., Regulations 2, 18 bis, 46; ISA, 2024a) but make no reference to the sufficiency of such information. In a rather evidence-limited space such as many deep-sea environments, the best available information might not be adequate or sufficient to make informed decisions about managing this environment and ensuring its long-term protection. Thus, the ISA should not only determine whether the level of information provided in an EIS or EMMP is sufficient to make an informed decision, but also understand the extent to which the information on which its decision is based might be inadequate or uncertain (DOSI, 2024).

At the same time as the work on the draft regulations progresses, the ISA is also developing Regional Environmental Management Plans (REMPs) which are proactive area-based management tools with the aim of balancing resource development with preservation of the marine environment for areas with current or future mining interests (ISBA/25/C/37; ISA, 2019c). REMPs are designed, following the principles of integrated ecosystem-based management, to protect biodiversity as well as ecosystem structure and function across the region for which they are designed (ISA, 2019a). The first REMP was implemented in the CCZ in 2012 (ISBA/18/C/22; ISA, 2012) and contains a network of 12 (initially nine) Areas of Particular Environmental Interest (APEIs). APEIs are exclusion zones outside of contract areas which are protected from future exploitation of mineral resources. In July 2025, the Council adopted a revised standardised procedure for the development, establishment and review of REMPs (ISBA/30/C/L3/Rev.1; ISA, 2025b) with three further REMPs being in development, namely, the Indian Ocean triple junction REMP, Northwest Pacific Ocean REMP and the Northern Mid-Atlantic Ridge REMP. Although the implementation of REMPs in itself is not binding, the draft exploitation regulations provide for REMPs being part of the Mining Code indirectly. For instance, an application for a PoW for exploitation should only be considered if a REMP has been adopted for the area and resource concerned (draft Regulations 8(4), 15 2. (vii) and 44 bis (1); ISA, 2024a).

8. The ISA and a moratorium on deep-sea mining

Just as the ISA has to fulfil two seemingly conflicting remits – on the one hand, promoting and managing the seabed mineral resources in the Area under the principle of the common heritage of humankind (UNCLOS, Article 136) and, on the other, protecting the marine environment from harmful effects of deep-sea mining – views on a moratorium on deep-sea mining diverge across ISA member states. Although not an agenda item at ISA meetings in 2024 and 2025, many delegations referred to the subject of a moratorium or precautionary pause in their interventions, and the number of ISA members supporting a moratorium, ban or precautionary pause increased to 38 (Eni-ibukun et al., 2025), more than a fifth of ISA member states. Other states want to see exploitation of mineral resources to commence. China, for instance, stated in 2024 that a moratorium might hinder the operationalisation of the principle of the common heritage of humankind and thereby would be against the spirit of UNCLOS. Other members noted the opposite, that is, that a moratorium would support the spirit of UNCLOS and the precautionary principle (e.g., Greece). Several states stated their opposition to the submitting of applications for, and provisional approval of, PoWs for exploitation until a knowledge-based and robust Mining Code is in place (Australia, Brazil, Germany, UK, Zimbabwe and others; Tsioumanis et al., 2024).

In the context of DSM, 'moratorium', 'precautionary pause' and 'ban' are often used synonymously without a clear shared understanding (Singh et al., 2025). Both a precautionary pause and a moratorium call to postpone, defer, or suspend the granting of exploitation licences by the ISA and thus can be seen as temporary 'non-use measures'. Neither of these calls extend to explorative activities or halting the development of the Mining Code. Instead, their effect would be a freezing of the status quo until certain pre-agreed conditions are met (e.g., filling existing knowledge gaps). A ban, on the other hand, implies a complete ceasing of all deep-sea mining activities in the Area, that is, explorative and exploitative. France is the only country supporting such a ban for the Area, with 37 countries supporting either a precautionary break or a moratorium (as of August 2025; Eni-ibukun et al., 2025). Arguably, UNCLOS provides reasons for and against such 'non-measures'; it will be up to the ISA member states to decide which way to go (Singh et al., 2025).

The reasons underlying calls for a moratorium or precautionary pause are manifold and reach beyond concerns about the protection of the marine environment from harmful effects from deep-sea mining. As indicated in Section 5, many stakeholders and member states are concerned about provisions making the LTC indirectly the decision-maker on applications for PoWs. Furthermore, the requirement to find a high level of consensus across the Council in order to decide against a recommendation by the LTC to approve an application for a PoW might lead to Council members who are sponsoring states being disinclined to support such disapproval for fear of future negative repercussions for applications by their own

sponsored contractor(s). The near 'default setting' for approving applications for a PoW automatically, should the Council not reach a decision on such recommendation within 60 days, adds to these concerns.

Whether the change in leadership (the new Secretary-General Leticia Carvalho was elected in July 2024 and came into office in January 2025) will bring agreement in and progress on these opposing views on deep-sea mining in the Area remains to be seen. Carvalho's statement, prior to her election (Mongabay, 2024) – that conciliation between such opposing views could be possible and that, in her understanding, a precautionary pause is 'an ask for reflection, and an opportunity for the ISA to really embrace that', as such reflection and opportunity 'was the vision of the Law of the Sea' – provides hopes for a more unifying approach at the helm of the ISA.

9. Relevant multilateral environmental agreements

Although the ISA is the Authority for activities relating to deep-sea mining in the Area, neither it nor its regulatory framework, the Mining Code, work in isolation (Singh and Jaeckel, 2024). UNCLOS acknowledges obligations member states have under other conventions regarding environmental protection (Article 237), and such obligations have, according to the Vienna Convention on the Law of Treaties (United Nations, 1969), to be considered in the interpretation of UNCLOS (Article 31). This section provides an overview of those international agreements that are of particular relevance in the context of protecting the marine environment from harmful effects of mining activities in the Area and, furthermore, highlights potential overlaps in competences with other relevant authorities, emphasising the need for advance cooperation, consultation and coordination between the ISA and such authorities.

9.1. Agreements adopted under UNCLOS: UN Fish Stocks Agreement and BBNJ Agreement

The already mentioned UN Fish Stocks Agreement (United Nations, 1995), an UNCLOS-implementing agreement, requires states to maintain the integrity of marine ecosystems. In 2009, the FAO introduced the concept of Vulnerable Marine Ecosystems (VMEs) in their guidelines for the Management of Deep-sea Fisheries in the high seas. VMEs are areas that are functionally or physically fragile and thus may be vulnerable to impacts from fishing activity, in particular, from bottom-contacting fishing gear. Most VMEs consist of benthic ecosystems and/or contain fragile benthic habitats and species (e.g., sponge gardens, coral reefs, seamounts). The protection of VMEs is now firmly embedded in legal regimes for the management of deep-sea fisheries, not only in ABNJ but also in the EEZ of many UN member states, and the concept has been proposed as a tool for the designation of REMPs (Blanchard and Gollner, 2022).

The recently ratified 'Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction' or BBNJ Agreement (United Nations Assembly, 2023), is probably the agreement most relevant to deep-sea mining. BBNJ closes a gap in governance regarding the management of biological resources, that is, marine biodiversity in ABNJ (Christiansen et al., 2022; Gjerde et al., 2022). While UNCLOS pertains to the mineral resources of the Area, that is, the ocean floor and its subsoil (UNCLOS, Article 1), BBNJ applies to the biological resources of the high seas as well as the Area (BBNJ, Article 1). The main remit of BBNJ is 'to ensure the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, for the present and in the long term through effective implementation of UNCLOS and further international cooperation and coordination' (BBNJ, Article 2). Most importantly, BBNJ provides the legal framework to implement measures to support maintaining and restoring ecosystem integrity in the oceans (BBNJ, Article 7). Such measures include (i) area-based management tools such as Marine Protected Areas (MPAs), (ii) environmental impact assessments for any activity that 'may cause substantial pollution of or significant and harmful changes to the marine environment', (iii) access to and benefit-sharing of marine genetic resources, and iv) capacity building and technology transfer. The implementation of MPAs in ABNJ, for example, has been challenging in the past, albeit provisions for meeting this challenge exist under some international conventions, for example, CCAMLR (1980) and IMO (Roberts, 2024), and regional agreements, for example, OSPAR (Molenaar and Oude Elferink, 2009).

Although urgently required for the implementation of conservation measures for our globally interconnected oceans, building the foundations for the necessary cooperation and coordination across states and the many regional and international organisations and bodies that govern and manage our oceans, is a daunting task. As was the case for almost all multilateral environmental agreements, it seemed reasonable to expect that it would take several years for the BBNJ Agreement to come into force. First, as was also required for UNCLOS, 60 states must ratify it (BBNJ, Article 68). Remarkably, this milestone was reached already in September 2025; and by the end of September 2025, the number of parties having ratified BBNJ had increased to 74 including the EU (United Nations, 2025). Thus, it took little more than a year to ratify BBNJ which will enter into force January 17, 2026. The first meeting of the Preparatory Commission for the entry into force of BBNJ and the convening of the first meeting of the Conference of the Parties took place already and concluded after its second session in August 2025.

9.2. Other relevant UN conventions

Several other UN agreements are also relevant to deep-sea mining in the Area, for instance, the UN Convention on Biological Diversity (United Nations, 1992). It obliges member states to conserve biodiversity and prevent species loss, to use biodiversity in a sustainable manner and to share the benefits arising from the use of genetic resources in a fair and equitable way. Under the recent

2022 Kunming-Montreal Global Biodiversity Framework (2022), states are committed to protect 30% of all marine areas by 2030.

The Sustainable Development Goal 'Life Below Water' is the main marine development goal of the UN '2030 Agenda for Sustainable Development' (see SDG14 in United Nations, 2015) with the objective to conserve and sustainably use the oceans, seas and marine resources for sustainable development. This goal focusses on increased efforts and interventions to conserve and sustainably use ocean resources at all levels, including ocean acidification, fish stocks, protected areas, illegal, unreported and unregulated fishing and small-scale fishers' access. The Convention on the Conservation of Migratory Species of Wild Animals (CMS, 1979) or Bonn Convention (entered into force in 1983), is also relevant to deep-sea mining in the Area as such activities might impact migratory species, their global conservation being one of the main purposes of the CMS Convention.

Unlike the aforementioned conventions, the International Convention for the Prevention of Pollution from Ships (MARPOL; International Maritime Organization, 1973) does not address the protection of biodiversity per se, but it is of relevance nevertheless to deep-sea mining in the Area. MARPOL is the main international convention on prevention of pollution of the marine environment by ships from operational or accidental causes.

10. Potential overlap in remit and jurisdiction of competent authorities

Besides this multitude of existing legal frameworks pertaining to the protection of the marine environment, there are also several competent authorities regulating certain uses or activities on the high seas. In this 'crowded institutional landscape' (Kim, 2024) an overlap in interests and competencies between existing frameworks, institutions and bodies seems unavoidable. Indeed, the existing multitude of competencies is sometimes lamented as an unfortunate fragmentation of the Law of the Sea into both regional and sectoral dimensions (Mendelson, 1988). When it comes to deep-sea mining, there are several such areas of overlap specifically regarding environmental protection.

Until the Mining Code has been completed and adopted by the ISA, any consideration of the implications of potential overlap in interests and competency between the ISA's Mining Code and other regulatory frameworks can only be preliminary. In view of the recently agreed BBNJ Agreement, this situation can also provide an opportunity for alignment between the two regimes by including BBNJ principles in the exploitation regulations. For instance, the role of traditional knowledge of indigenous peoples and local communities, the rights of indigenous people being an underlying principle of the BBNJ (Preamble), has been included in the revised consolidated text (ISBA/30/C/CRP.1; ISA, 2024a). In 2024, the ISA published a report determining how BBNJ provisions might apply to activities in the Area and identifying linkages between the mandates of the ISA and BBNJ objectives, and potential opportunities and challenges in the relationship between the ISA and institutions to be established under BBNJ (ISA Secretariat, 2024). Challenges identified are, for example, around the equivalency of EIAs carried out under the Mining Code and under BBNJ and the remit to introduce area-based management tools (ABMTs) in the Area (Robb et al., 2023). Although both could lead to more protection overall, they could also lead to conflict when, for instance, an MPA is proposed under BBNJ in areas for which the ISA already has contractual arrangements. As other organisations also have the remit to implement ABMTs in the Area, good institutional cooperation and coordination will have to be developed to ensure engagement, harmonisation in efforts and productive overall decision-making in the spirit of UNCLOS, while respecting the competencies of all relevant organisations. For the ISA, however, the coming into force of the BBNJ Agreement clearly will not change its predominant role in regulating deep-sea mining activities in the Area due to its exclusive mandate given by UNCLOS, and that any guidance developed by the BBNJ Agreement in this context has to be coherent with the procedures already in place for activities in the Area (ISA Secretariat, 2024).

Tensions between the ISA and relevant organisations have already arisen. The 2024 call of the Secretariat of the CMS for a resolution supporting a pause on deep-sea mining (UNEP/CMS/COP14/Doc.27.2.4/Rev.1.; CMS, 2024a), for instance, led to the ISA Secretary-General criticising the CMS for the use of incorrect factual and legal statements and being biased in the selection of evidence presented to its members (UNEP/CMS/COP/inf.27.2.4; CMS, 2024b). The CMS nevertheless adopted the resolution but decided also to collaborate with the ISA and other relevant bodies on the impact of deep-sea mining on migratory species (UNEP/CMS/Resolution 14.6; CMS, 2024c). A further example of potential conflict might arise between the ISA and OSPAR, the Regional Sea Convention for the Protection of the North-East Atlantic, regarding OSPAR's mandate to implement MPAs in its maritime area, approximately 40% of it being in ABNJ. Since 2010, OSPAR has established 8 MPAs that are partly in ABNJ (Tang et al., 2021). Most are the so-called High Seas MPAs designated for the protection of water column features (e.g., cetaceans, seabirds, ecological processes of the water column) and, thus, are not under the remit of the ISA. The North Atlantic Current and Evlanov Sea Basin MPA, however, is designated to protect, conserve, maintain and restore, among others, 'the integrity of ecosystems of the seabed, ocean floor and subsoil thereof' (OSPAR, 2021a). Should the mineral deposits identified in the MPA (OSPAR, 2021b; revised 2023) become of commercial interest, however, a question of competence between the authorities might arise. Such a development would also be a test for the existing Memorandum of Understanding according to which 'appropriate coordination of measures in order to conciliate the development of mineral resources with comprehensive protection of the marine environment' will have to be put into place (OSPAR Commission, 2010). After all, the exclusive competence of the ISA in organising and controlling activities in the Area does not extend to exclusivity in terms of protection of the marine

environment. A possible way forward for the ISA might be for the S&G documents pertaining to EMMPs to contain a clause to respect and adhere to protection measures already implemented by other competent authorities in or in the vicinity of ISA contract areas.

The overlap in remit and jurisdiction between the ISA and other authorities is not limited to environmental protection. Competing interests between the ISA and other sectors have been identified by, for instance, Singh and Jaeckel (2024), Friedman (2024), and more sector-specific, Chircop et al. (2024), Lily et al. (2024) and Amon et al. (2023). This existing plethora of remits, interests and competencies in the governance and management of our oceans does not bode well for a truly integrated and holistic approach to their governance (Boyes and Elliott, 2014). How such governance can be realised in the context of UNCLOS, the Mining Code, the BBNJ Agreement and other existing marine frameworks remains to be seen. Considering that one of the objectives of the BBNJ Agreement is to strengthen and enhance cooperation among relevant legal instruments and frameworks and relevant global, regional, subregional and sectoral bodies (Article 8), the time may have arrived to move from bilateral memoranda of understanding between competent authorities to a multilateral way to address questions of competing remits and overlapping mandates regarding environmental conservation in areas beyond national jurisdiction.

11. Conclusions

As can be surmised from this overview, the amount of work, discussions and negotiations required to be completed by the ISA before the exploitation regulations can be adopted is considerable. Considering that the ISA follows the principle that 'nothing is agreed until everything is agreed' (ISBA28/C/11/Add.2), all regulations, standards and guidelines need to be in place before the exploitation regulations can be adopted. At this stage, the issuing of a contract by the ISA for exploitation in the Area seems unlikely until the Council has agreed and adopted the complete Mining Code (preamble ISBA/28/C/24 and ISBA/28/C/25; ISA, 2023b; 2023c). Completion of the Mining Code and adoption of the exploitation regulations has now moved to 2026 or beyond. Too many issues are still outstanding, and the RRPs are far from complete, with several S&G documents still needing to be developed. Whether the completed Mining Code will be comprehensive enough to enable the exploitation of marine minerals in a sustainable manner without causing harmful effects to the environment, while being based on the principle of equitability – as set out in UNCLOS – remains to be seen.

With the first application for a commercial mining permit in the Area having been submitted under U.S. law, the ISA, and especially the LTC, might find itself under increased pressure to adopt exploitation regulations, particularly should other operators follow TMC's example and apply for an exploration licence or a commercial permit in the Area using the same avenue – as Secretary-General Leticia Carvalho very pointedly noted in her opening statement for the 30th ISA meeting (July 2025): 'The Deep Sea needs Rules' (Carvalho, 2025). In creating these rules, the ISA does not only have a substantial task ahead of it, but it must complete this task under the eyes of the (geopolitically interested) wider public and the scrutiny of an increasing number of supporters of a moratorium or pause on deep-sea mining.

Wadding through the plethora of existing regional and international legal frameworks relevant to deep-sea mining as well as the competencies of the numerous international organisations and bodies tasked with protecting the broader marine environment, one cannot help but ask, what is the relationship between all these different players? Now would seem timely for them, especially in light of the BBNJ agreement shortly coming into force, to work more closely together, identify overlaps and possible gaps in their competencies, and work towards alignment of their common goal – the protection of the marine environment for the common good of humankind and the well-being of our planet.

Supplemental files

The supplemental file for this article can be found as follows:

Table S1. List of abbreviations and terms. File in DOC format.

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