

## Article

# Taking Precautionary Approaches to the Governance of Commercial Deep Seabed Mining: Law-Making of International Seabed Authority and Multi-Subject Participation

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**Abstract:** Although commercial deep seabed mining could provide the international community with new sources of metals and minerals, it can potentially cause adverse effects on the marine environment and biodiversity of the Area. To date, insufficient scientific knowledge has been obtained about the complex deep seabed ecosystems and the detailed impacts of deep seabed mining. The International Seabed Authority has begun to make provisions for exploiting mineral resources and related environmental protection requirements. The draft exploitation regulations take precautionary approaches such as stipulating rules, including environmental standards and guidelines, environment impact assessment, environmental management and monitoring plan, and regional environmental management plan. However, there are still apparent differences and controversies about these rules between States. This article elaborates on the evolution and content of drafted rules and explores the manifested specific divergences and interest conflicts in formulating these rules. Implementing precautionary approaches requires balancing potential serious environmental risks, available scientific evidence, and cost-effectiveness. This article also explores the essential requirements of taking precautionary approaches for governing commercial deep seabed mining. The ISA, sponsoring States, Contractors, scientists, experts, and public all play roles in the governance of imminent commercial deep seabed mining. Strengthening multi-subject participation in the ISA's law-making process for deep seabed environmental protection can be conducive to promoting consensus on taking precautionary approaches to govern commercial deep seabed mining.

**Keywords:** precautionary approaches; International Seabed Authority; deep seabed mining; exploitation regulations; multi-subject participation; environmental impact assessment; environmental management and monitoring plans; regional environmental management plan



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## 1. Introduction

The ocean plays a vital role in global sustainable development, such as adjusting temperature, absorbing carbon dioxide emissions, and providing other ecosystem services. The deep seabed is the habitat of many rare and unknown creatures, forming unique ecosystems which remain the least explored on Earth. Additionally, the Area, which means the seabed and ocean floor and subsoil beyond the limits of national jurisdiction, contains rich mineral resources [1]. With the development of marine science and technology, the exploitation of deep seabed mineral resources has gradually gained increasing attention. The possible main impacts of deep sea mining on the seafloor include the depletion or physical damage to the habitat and fauna by the mining equipment, changes in seafloor topography and geochemical characteristics, creation of sediment plumes, and potential toxicity from metal or process chemical release [2]. For example, sediment plumes generated during mineral extraction are considered a major risk to deep sea ecosystems resulting in the burial and clogging of animals' feeding apparatus [3]. Seabed disturbance experiments

such as the German project DISCOL (disturbance and recolonization experiment) and follow-up study, MIDAS (managing impacts of deep sea resource exploitation), presented the potential for the release of toxic elements during the mining process and the difficulty of predicting the impact of release using data from laboratory experiments involving only one element [4].

The United Nations Convention on the Law of the Sea (hereinafter referred to as “UNCLOS” or “the Convention”) and the Agreement relating to the Implementation of Part XI of the UNCLOS provide the basic legal framework for activities in the Area. The Article 140 of the Convention stipulates that activities in the Area shall be for the benefit of all mankind. Paragraph 1 of Article 157 of the Convention and Article 1 of Annex I of the Agreement relating to the Implementation of Part XI of the UNCLOS stipulate that the International Seabed Authority (hereinafter referred to as “ISA” or “the Authority”), as the competent international organization that manages the Area, is responsible for organizing and controlling mineral exploitation activities in the Area. The ISA shall take measures in accordance with this Convention with respect to relevant activities in the Area to ensure that the marine environment is not adversely affected by such activities [5]. The ISA can establish appropriate rules, regulations, and procedures. Since the establishment of the Authority, the exploration regulations for polymetallic nodules, polymetallic sulphides and cobalt-rich nodules, and a regional environmental management plan have been formulated. The ISA allows interested entities to apply for exclusive rights over a certain area. It is granted in the form of contracts extending over a period of 15 years and covering a defined geographical area. Moreover, the terms and conditions entailed with each contract are determined according to the exploration regulations, obliging every Contractor to conduct detailed oceanographic baseline studies to assess their environmental impact and demanding a “precautionary approach” to prevent pollution and other harmful effects on the ecosystem [6].

The Draft Regulations on Exploitation of Mineral Resources in the Area is an important legal instrument formulated by the ISA to regulate the exploitation of mineral resources in the Area. The Legal and Technical Commission prepared the first working draft of the regulations and standard contract terms on the exploitation for mineral resources in the Area in 2016 and released the Draft Regulations on the Exploitation of Mineral Resources in the Area in 2017. The draft was revised again in 2018 and 2019. The bulk of the ISA draft regulations establish procedures for granting contracts to exploit deep sea minerals. Part II sets out the application and approvals process, Part III the rights and obligations of Contractors, Part IV the protection and preservation of the marine environment, Part V review and modification for work plans, Part VI closure plans, and Part VII financial terms. These provisions primarily aim to establish the commercial relationship between the Contractor and the ISA, and represent efforts to manage risks associated with commercial deep seabed mining governance [7]. The environmental rules in the Draft Regulations on Exploitation of Mineral Resources in the Area mainly include environmental standards, environmental management, environmental impact assessment, pollution control, restriction on mining discharges, and environmental compensation fund. Compared with the environmental rules in the three exploration regulations previously formulated by the ISA, the environmental rules in the draft regulations on the exploitation of mineral resources in the Area have added several new systems.

However, the interests of the ISA member States are inconsistent, and their preferred environmental protection solutions for commercial deep seabed mining are widely divergent. Currently, the content of environmental rules in the draft regulations still needs to be further negotiated. For example, Germany suggests that fully developed and agreed Regional Environment Management Plans (REMPs) should be regarded as a prerequisite for granting exploitation licenses [8]. Key priorities from the UK’s perspective include ensuring the highest possible environmental standards [9]. Japan reaffirmed that it is essential to formulate reasonable Regulations, properly striking a balance between exploitation and environmental considerations, that are indispensable for the realization of deep sea

exploitation [10]. As another example, the Contractors shall carry out exploitation with reasonable regard for other activities in the marine environment. States have different views on whether the Contractors need to comply with “any applicable international rules and standards established by competent international organizations”. Opponents say it is unclear and too broad [11].

Until now, the international community’s scientific understanding of the deep sea ecosystem remains relatively limited. Moreover, commercial deep seabed mining may impact the marine environment of the Area. A rights of nature approach could be applied to the oceans [12] alongside the precautionary approach and sustainable development concepts [13]. The Nodules Exploration Regulations, Sulphides Exploration Regulations, and Crusts Exploration Regulations all specifically oblige the ISA and sponsoring States to “apply a precautionary approach, as reflected in the principle of the Rio Declaration on Environment and Development (hereinafter as the Rio Declaration), and best environmental practices”. Similar obligations apply to Contractors and prospectors. The concept of precaution shall be reflected in the governance of commercial deep seabed mining. Principle 15 of the Rio Declaration stated that in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be a reason for postponing cost-effective measures to prevent environmental degradation. The precautionary approach is incorporated in the Draft Regulations on Exploitation of Mineral Resources in the Area. Regulation 2: “Fundamental policies and principles” of the draft emphasizes that for the effective protection of the marine environment from the potentially harmful effects caused by exploitation, the precautionary approach, as reflected in principle 15 of the Rio Declaration shall be applied. Regulation 44: “general obligations relating to the marine environment” formulate that the ISA, sponsoring States and Contractors shall apply the precautionary approach to the assessment and management of the risk of harm to the marine environment from exploitation in the Area [14]. Therefore, the application of precautionary approaches is not only one of the basic principles of the draft exploitation regulations, but also one of the general obligations to protect and preserve the marine environment in deep sea mining activities. However, the draft currently lacks precise criteria and directions on how each actor should implement the precautionary approach. Until now, it is up to States and Contractors to identify the appropriate measures for applying the precautionary approach [15].

This article introduces and analyzes how the precautionary approach is applied in the environmental rule-making of the Regulations on Exploitation of Mineral Resources in the Area and provides recommendations to emphasize and pursue multi-subject participation in the environmental rule-making process of ISA. For the aim, this article will firstly analyze the precautionary approach and its development in the international law of the sea, explain the evolution and content of the rules that reflect the precautionary approach in the draft exploitation regulations, and explore the differences of views of parties on formulating relevant environmental rules. Implementing the precautionary approach needs to strike a balance between potentially serious environmental risks, available scientific evidence, and cost-effectiveness. This article also examines the basic requirements for the precautionary approach to managing commercial deep seabed mining and how to strengthen multi-subject participation in the law-making process of the deep seabed environmental protection of the ISA to promote the consensus on adopting the precautionary approach for governance on commercial deep seabed mining.

This article applies traditional desk research methods, analyzing primary sources (regulations and States’ comments) and secondary sources (academic discussion). Regulations include relevant rules of the UNCLOS and its implementation agreement, Convention on Biological Diversity, ISA’s existing regulations, guidelines and the draft regulation. The States’ comments on the Draft Regulations on the Exploitation of Mineral Resources in the Area and their difference or coherence are analyzed. In addition, the *Southern Bluefin Tuna* case and the Regional Environmental Management Plan for the Clarion-Clipperton Zone

are chosen as case studies to illustrate the connotation of precautionary approaches and the related practice of ISA, respectively.

## 2. The Precautionary Approach and Its Application in the International Law of the Sea

### 2.1. Defining the Precautionary Approach

With the rapid development of science and technology, the threat of human activities to the ecology and environment has become increasingly significant. International law requires States to abide by the principle of good neighborhood when dealing with transboundary environmental damage; that is, any State shall undertake prevention responsibilities for transboundary environmental hazards and foreseeable environmental risks caused by the activities under its jurisdiction or control [16]. This principle has gradually developed into international customary law and is stipulated in some international agreements. The Article 194 of the UNCLOS stipulates that States shall take all measures consistent with this Convention that are necessary to prevent, reduce, and control marine environment pollution from any source, individually or jointly as appropriate. Based on the principle of good neighborliness, States have the obligation not to cause damage to the environment beyond national jurisdiction and take responsibility for the damage caused by activities under their jurisdiction and control. However, due to the limitations of human cognition and the complexity of the ecological environment, there is always a lack of scientific certainty about environmental risks caused by human activities. Therefore, the traditional State responsibility model which is based on definitive scientific evidences, may lead to environmental degradation and irreversible losses. The concept of precaution aims to oblige States to take a precautionary approach to solve environmental problems promptly based on reasonable doubts, even there, is insufficient scientific evidence. Principle 15 of the Rio Declaration is regarded as an important symbol for establishing this concept in international law. The concept of precaution was gradually introduced to various fields dealing with environmental issues, such as marine biodiversity loss, dumping, ozone layer problems, and greenhouse effects.

It is generally believed that the concept of precaution includes three elements: the threat of environmental risks, scientific uncertainty, and taking measures. Firstly, there is a certain environmental risk, and the risk has reached a degree of suspicion. Secondly, there is scientific uncertainty, such as whether there is environmental harm and whether there is a causal link between that harm and the activity. Finally, scientific uncertainty cannot be a reason for postponing measures to prevent environmental degradation. The threat of environmental damage is the fundamental reason for formulating precautionary measures; scientific uncertainty is the premise of applying a precautionary approach [17]. Furthermore, applying the precautionary approach does not require unlimited precautions to avoid environmental damage. States can take cost-effective measures according to their respective capabilities by applying the precautionary approach. The precautionary approach is a soft approach, which has more flexibility and takes into account social and economic conditions in the implementation process [18]. The precautionary approach has been gradually reflected in many international legal instruments and has been applied and developed in the field of international law of the sea.

The status of precaution is disputed. In practice, some scholars believe that the precautionary principle is an international customary law rule, and precaution is a guiding principle in EU law [19]. However, other scholars believed that the precaution could not be used as a legal principle of international customary law to bind all members of the international community. The legal nature of the precautionary principle is vague, and its legal status is still controversial in international law. It has not yet developed into international customary law and cannot be used as a general legal principle to bind all members of the international community [20]. Compared with the precautionary principle, the precautionary approach is generally considered to be more flexible and tends not to be legally binding. For example, Judge Liang believed that the precautionary approach is more flexible in the 1999 *Southern Bluefin Tuna* case. Judge Shearer stated that applying

the precautionary approach, rather than the precautionary principle, is more flexible in dealing with the relevant issues [21]. The precautionary approach is more flexible and can incorporate socio-economic factors, while the precautionary principle is associated with complex conservation schemes and is considered incompatible with sustainable development. The precautionary approaches are flexibility measures to prevent human activities from possible risks when the causal relationship is uncertain.

In the formulation of the draft exploitation regulations, States showed noticeable differences on whether precaution is a general principle or an approach. Although Article 46 of the draft refers to the precautionary approach reflected in principle 15 of the Rio Declaration, the UK advocated that it should refer to the precautionary principle rather than the precautionary approach [22]. However, Australia pointed out that it agreed with Article 46 to apply the precautionary approach, emphasized the importance of being flexible to cope with scientific and technological progress, and believed that the principle of sustainable development should also be referred to [23]. The precautionary approach is more consistent with the concept of sustainable development. The concept of sustainable development is reflected in the balance between environmental interests and economic and social interests, ensuring environmental interests without excessively sacrificing social and economic interests. In practice, the precautionary principle usually stipulates prohibitive measures, such as the complete prohibition of large-scale pelagic driftnet fishing in order to protect fishery resources. The precautionary approach is more conducive when considering environmental, economic, and social interests in its implementation process, and could promote the realization of sustainable development.

## *2.2. Application of the Precautionary Approach in the International Law of the Sea*

Article 5 and 6 of the United Nations Agreement for the Implementation of the Provisions of the UNCLOS relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (hereinafter referred to as the “1995 Fish Stock Agreement”) clearly states that coastal States and States shall apply the precautionary approach widely to conservation, management, and exploitation of straddling fish stocks and highly migratory fish stocks to protect the living marine resources and preserve the marine environment. Article 6 of the 1995 Fish Stock Agreement regulated the specific requirements of States for implementing the precautionary approach, which includes improving decision-making by obtaining and sharing the best scientific information available and implementing improved techniques for dealing with risk and uncertainty. The 1995 Fish Stock Agreement reinforces a dichotomy that making provision for the regulation of new and exploratory fisheries constitutes a core component of applying the precautionary approach to fisheries management, and such activities should in turn proceed in a graduated, monitored, and precautionary manner [24]. In addition, annex II of the Agreement sets out guidelines for applying precautionary reference points in the conservation and management of straddling fish stocks and highly migratory fish stocks. The 1992 Convention on Biological Diversity and the 2020 Cartagena Protocol on Biosafety to the Convention on Biological Diversity also contain references to the precautionary approach to marine biodiversity [25]. The 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Waster and Other Matter (London Protocol) expressly introduced the precautionary approach to environmental protection from dumping.

The precautionary approach is also reflected in some regional sea agreements. For example, according to Article 2 of the Convention for the Protection of the Marine Environment of the North-East Atlantic (the ‘OSPAR Convention’), the parties to the Convention need to apply the precautionary principle, by which preventive measures are to be taken when there are reasonable grounds for concern that substances or energy introduced into the marine environment, directly or indirectly, may bring about hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea, even when there is no conclusive evidence of a causal relationship between the inputs and the effects. The Commission for the Conservation of Antarctic

Marine Living Resources (CCAMLR) is also considered a good example of applying the precautionary approach. The CCAMLR seeks to protect ecosystems by setting precautionary krill catch limits, considering the needs of associated species in a manner that protects their ecological sustainability. A spin-off of CCAMLR's pioneering work on the precautionary and ecosystem approach is now regarded as the model of regional fisheries management bodies worldwide.

### 3. The Environmental Rule-Making of Exploitation Regulations and Precaution

#### 3.1. Requirements for Applying Precautionary Approaches to Managing Deep Seabed Mining

Currently, only limited knowledge of the deep sea ecology and environment is obtained, and deep seabed mining may potentially impact the marine environment. In order to protect marine biodiversity and ecological environment, the precautionary approach should be applied to the governance of deep seabed mining. Under the mandate of Part XI of the UNCLOS, the ISA manages the seabed, ocean floor, and subsoil beyond national jurisdiction on behalf of all mankind. The General Assembly of the Authority, composed of all its member States, is the nominally supreme authority to which all other principal institutions are accountable. The Council has the right to formulate environmental rules in the Area. The members of the Council's various groups play an important role in the decision-making process of environmental rules, which are divided into five groups: A, B, C, D, and E. The first three groups are composed of four member States; group D and E are composed of 6 and 18 member States, respectively. Among them, group A must include Member States whose future consumption of mineral resources imported from the Area exceeds 2% of the total consumption of mineral resources in the world. Group C is composed of terrestrial mineral resource exporting States that compete with the production of deep seabed mineral resources, among which there must be at least two member States whose main source of income is the export of mineral resources. The members of group D include major importers of various seabed minerals and potential producers of such minerals. Since 2011, the ISA has explored developing rules for commercial deep seabed mining. As mentioned above, the draft exploitation regulations emphasize the application of precautionary approaches.

The precautionary approach is the core of an ecosystem approach to management and is a legally binding obligation on ISA, States, and Contractors [26]. According to the draft exploitation regulations, the ISA, the sponsoring State, and the Contractor all have an obligation to adopt precautionary approaches. The adoption or implementation of a precautionary approach places demands on the competence of the ISA. The ISA needs to provide precautionary decision-making for the environmental risks that may arise from deep seabed mining and take corresponding methods or measures. The Legal and Technical Committee plays an important role in formulating regulations for the ISA. The Legal and Technical Committee is a subsidiary body of the Council of the ISA, which is mainly responsible for supervising and managing activities in the Area based on the actual situation and making specific suggestions to the Council on protecting the Area's environment. However, the application of the precautionary approach needs to be based on certain scientific evidence. One way to implement the precautionary approach in deep seabed mining is to adopt measures that specifically target existing knowledge gaps to reduce the surrounding uncertainties [27]. Developing a knowledge management system to understand better the potential impacts of deep seabed mining operations would enable the ISA to adopt the necessary measures as required by Article 145 of UNCLOS [28]. Establishing a scientific and technical advisory body can provide scientific advice for the decision-making or rule-making of the Assembly and Council of the ISA. The composition requirements of the Council members of the ISA reflect the coordination of interests between mineral resource exporting States and mineral resource importing States. Contractors, on the other hand, have an indirect influence on the decision-making of the Authority mainly by exerting influence on their sponsoring States. From the procedural level, some scholars believe that the process of precaution mainly includes environmental impact assessment

and environmental monitoring [29]. Peel believed applying a precautionary approach requires rigorous assessment of scientific uncertainties, ensuring transparency in balancing competing interests, and expanding participation in the decision-making process [30]. The draft exploitation regulations need to provide the necessary scientific deliberation, balancing of interests and participation mechanism of a precautionary approach, while promoting marine scientific research and environmental impact assessment to minimize scientific uncertainty.

Applying a precautionary approach may facilitate the fulfillment of a sponsoring State's obligation of due diligence. It is necessary to take all appropriate measures to fulfill the obligation of due diligence as long as their activities have potential environmental risks, even in the absence of full scientific evidence of their adverse effects [31]. The precautionary approach aims to ensure a high level of environmental protection through the use of smart, risk-averting decisions. For this, the ISA needs to implement full modern transparency procedures, hold meetings of the Legal and Technical Commission in public, initiate full public comment and review procedures in the exploitation regulations, with respect to all matters, and issue open invitations to workshops developing policy and procedures [32].

### *3.2. The Development of Environmental Rule-Making in the Exploitation Regulations*

The draft exploitation regulations formulated by the ISA will be the legal instrument to regulate the exploitation of mineral resources in the Area. The content of environmental rules in the draft comprises the fundamental policies and principles of Part I and Part IV Protection and Preservation of the Marine Environment. The draft regulations clearly require the ISA, sponsoring States, and Contractors to jointly undertake the tasks of protecting the ecological environment in the Area and implementing relevant measures. The draft regulations stipulate that the ISA is responsible for formulating standards and requirements related to the environmental impact of exploitation activities. The environmental standards mainly include environmental quality objectives, monitoring procedures and mitigation measures. In the specific procedure for the Contractor to apply for exploitation, the ISA is responsible for announcing and reviewing the environmental impact assessment plan and evaluating whether the applicant has the technical capabilities for environmental protection that meet the standards and requirements.

The draft regulations also stipulate that when submitting an application, the Contractor must formulate the environmental impact statement and environmental management and monitoring plan in accordance with the regional environmental management plan according to the relevant provisions of Annex IV and VII, and take necessary measures to prevent, reduce, and control the pollution and other hazards to the Area's environment from mining activities (Table 1). In addition, before production, the Contractor shall lodge an environmental performance guarantee in favor of the ISA to provide guarantees for complying with relevant environmental obligations during the mining process. The draft also stipulates that a Contractor shall submit a final closure plan to ISA, at least 12 months prior to the planned end of commercial production, or as soon as is reasonably practicable in the case of any unexpected cessation. The Contractor shall continue to monitor the marine environment for such a period after the cessation of activities, as set out in the final closure plan. Regulation 54 of the draft also expressly stipulates the establishment of an environmental compensation fund to prevent, limit or remediate any damage to the Area arising from activities in the Area.

**Table 1.** Environmental Requirements for Contractors on Different Stages in the Draft Exploitation Regulations.

Environmental Requirements for Contractors	
<b>Submission of Application</b>	<ul style="list-style-type: none"> <li>① The application should include the environmental impact statement (Regulation 7(3)(d) and Annex IV of the draft) and the environmental management and monitoring plan (Regulation 7(3)(h) and Annex VII).</li> <li>② Deposit an environmental performance guarantee in favor of the Authority (Regulation 26(1)).</li> </ul>
<b>Exploitation</b>	<ul style="list-style-type: none"> <li>① The annual reports should include the actual results obtained from the environmental monitoring programs (Regulation 38(2)(g))</li> <li>② Taking necessary measures to prevent, reduce, and control pollution and other hazards in accordance with the environmental management and monitoring plan and applicable standards and guidelines (Regulation 49).</li> <li>③ No dispose, dump or discharge into the Marine Environment or any mining discharge, except where such disposal, dumping or discharge is permitted (Regulation 50(1)).</li> <li>④ Compliance with the environmental management and monitoring plan (Regulation 51).</li> <li>⑤ Conducting performance assessments of the environmental management and monitoring plan (Regulation 52(1)).</li> </ul>
<b>Closure</b>	<ul style="list-style-type: none"> <li>① The Environmental Performance Guarantee reflects the likely costs required for post-closure monitoring and management of residual environmental effects. (Regulation 26(2)(c))</li> <li>② The Contractor shall continue to monitor the marine environment within the period stipulated in the final closure plan (Regulation 61(2) and Annex VIII).</li> <li>③ The closure plan shall be prepared and implemented according to the guidelines and the relevant regional environmental management plan; the closure plan shall include an updated environmental impact assessment for the activities that will be undertaken during closure, and the details of the identifiable residual environmental effects; the closure plan shall include details of management measures to mitigate residual environmental effects; the closure plan shall include details of the amount of the environmental performance guarantee (Appendix VIII).</li> </ul>

There is a general recognition among stakeholders that further work is needed on the regulations related to protecting the marine environment. However, the content of environmental rules in the draft regulations still needs to be further discussed. Some States emphasized that the development of standards or guidelines related to the marine environment should be prioritized, including environmental impact assessment, preparation of environmental impact statements, environmental management and monitoring plans, and closure plans. Others suggested that all matters related to environmental protection should be listed in the standards. Some stakeholders also suggested that a manual should be developed on the monitoring and assessing activities before, during, and after the exploitation, including a detailed methodology for establishing an environmental baseline. At present, there are obvious differences between the opinions of States. States need to continue to discuss and try to reach a consensus around relevant environmental rules in subsequent negotiations.

### 3.3. Disputes over the Making of Environmental Rules in the Exploitation Regulations

There are different specific measures and procedures for implementing precautionary approaches. For example, a pause on mining activities may also be one of the measures to implement a precautionary approach. However, the pause of activities is not a necessary consequence of implementing a precautionary approach. Currently, the draft regulations lack standards and guidelines on how each participant implements precautionary approaches. Until the relevant standards and guidelines are developed by the Authority, it is primarily up to States and Contractors to determine how to implement appropriate precautionary approaches. There are several obvious disputes between States about the formulation of environmental rules of the draft regulations, especially in environmental impact assessment, environmental standards, environmental management and monitoring, and regional environmental management plans.



### 3.3.1. Scope of Environmental Impact Assessment

Deep seabed mining takes place in inaccessible areas of the deep seafloor, leading to considerable uncertainty about its effects on deep seabed ecosystems. Environmental impact assessment is an important precautionary approach. Environmental impact assessment is an assessment of the effects of a proposed mining action on the deep sea environment based on the available science and provides alternatives to the proposed action. A detailed environmental impact statement and an environmental management and monitoring plan are needed for the application and approval procedure of a plan of work. As part of the comprehensive review of an application, the Legal and Technical Commission shall examine the application in light of the comments made by stakeholders and the responses from the applicant, and consider whether the plans provide for the effective protection of the marine environment in accordance with article 145 of the UNCLOS and the precautionary approach [33]. The Contractor is responsible for providing evidence to the sponsoring State and the Authority that the nature or extent of adverse effects may be acceptable. In the formulation of the draft regulations, States have different opinions on the factors that should be considered in the environmental impact assessment. Article 47 of the draft regulations states that an environmental impact assessment should identify, predict, evaluate, and mitigate the biophysical, social, and other relevant effects of the proposed mining operation. However, France advocates that the environmental impact assessment should only be carried out according to strict environmental standards and should not consider the social consequences of the proposed mining activities, so as not to weaken the protection of the environment [34].

### 3.3.2. Necessary Environmental Standards and Guidelines

States also dispute over the formulation of the environmental standards of the Regulation. Germany believes that the environmental standards formulated by the ISA for deep seabed mining must be legally binding, and the approval of relevant environmental standards is the prerequisite for the ISA to allow exploitation activities [35]. Australia advocates that relevant coastal States should be consulted when formulating legally binding environmental standards [36]. Russia believes that what “the environmental acceptance criteria” mean and how these criteria will be established should be clarified [37]. The UK argues that ensuring the highest possible environmental standards should be a major priority [9]. Currently, the ISA is preparing to formulate the *Draft standard and guidelines on the form and calculation of an Environmental Performance Guarantee* [38]. However, due to the different procedures and legal effects of standards and guidelines, some States, including China, believe that this document is only suitable for specifying guidelines, not standards [39]. United States made comments on the *Draft standard and guidelines on the development and application of environmental management systems*, and advocated that specific and measurable environmental standards that Contractors need to meet should be clarified. The United States thought that setting an aspirational objective as the standard in the context of mining, e.g., preventing harm to the marine environment, is unrealistic and ignores the nature of this inherently destructive activity. Rather, this standard should address the question of what is an acceptable level of harm in calculable terms [40]. As the text of the draft exploitation regulations are being negotiated and eventually finalized, some or most of the drafts of the accompanying standards and guidelines that have been or are about to be issued by the LTC would need to be revisited and revised accordingly [41].

### 3.3.3. Implementation of Environmental Management and Monitoring

There are also differences among States regarding implementing environmental management and monitoring of the Regulation. In the opinion proposed by Germany in 2019, it is believed that the standards in the environmental management and monitoring plan must be legally binding, while the guidelines can be suggestive [35]. Japan, on the other hand, argues that environmental monitoring reports do not need to be formulated based on environmental objectives and standards [10]. Member States of the Latin American and

Caribbean Group collectively submitted a proposal at the 26th session of the Council in 2020, and expected that the Authority could be able to develop coherent environmental rules, including regional environmental management plans. The United States emphasizes that the implementation of environmental management measures should be based on the best available scientific evidence [42].

#### 3.3.4. Application of Regional Environmental Management Plans

Regional environmental management plans (REMPs) are considered to be a scientifically sound and effective tool for implementing precaution requirements. Consideration of the scale and location of mining activity, potential cumulative impacts from more than one mining operation, and understanding of connectivity in the region are key to prevent biodiversity loss. For this reason, REMPs, which the ISA has commenced to develop, will be important strategic environmental management tools [43]. In addition to the 2012 Regional Environmental Management Plan for the Clarion-Clipperton Zone, the ISA developed a strategy to prioritize the development of REMPs in Areas where exploration activities are currently underway. The Council has preliminarily agreed and identified the Mid-Atlantic Ridge, the Indian Ocean triple junction ridge and nodule-bearing province, as well as the North-West Pacific and South Atlantic for seamounts as priority areas. In the future, REMPs for these areas will be negotiated. Germany and the Netherlands, with Costa Rica as co-sponsors, submitted a proposal for the establishment, approval, and review process of regional environmental management plans, hoping that relevant standards can be developed as soon as possible to facilitate accountability and transparency, reliability and acceptability, clarify environmental standards, and level the playing field for Contractors [44]. They emphasize that the applicant is obliged to prove that its management and monitoring conform to the REMPs, and advocate that Article 49 of the draft regulations requires the Contractor to comply with the environmental management and monitoring plan, the applicable REMPs and the applicable standards and guidelines, and take necessary measures to prevent, reduce, and control pollution and other hazards to the marine environment caused by its activities in the region. France advocates avoiding confusion between environmental management and monitoring plans and REMPs. In addition, REMPs may also involve other ocean activities, such as fishing or navigation. However, the current level of interest of other sectoral organizations in participating in the development of REMPs seems limited, highlighting the current limitations of the sectoral approach. Furthermore, the stakeholder engagement strategy of the REMPs and the response mechanism to stakeholder comments and suggestions are needed [45].

### 4. Applying Precautionary Approaches in Deep Seabed Mining and Multi-Subject Participation

#### 4.1. The Necessity of Multi-Subject Participation

Governance of global common resources, especially when numerous uncertainties are involved, requires weighing societal risk and acceptability. The core issue is what level of environmental harm is acceptable to society [46]. The ISA provides for limited participation by external experts, primarily in the development of the Mining Code and regional management plans, through workshops and expert presentations at meetings of the Legal and Technical Commission [47]. As mentioned earlier, a precautionary approach should be applied where there is scientific uncertainty and the risk of environmental degradation. Meanwhile, the application of the precautionary approach needs to consider the capacity of each State and whether it is cost-effective, and take necessary preventive measures on this basis. Principle 15 of the Rio Declaration limits the application of the precautionary approach to “cost-effective measures to prevent environmental degradation” in response to “threats of serious or irreversible damage”. In the formulation of the draft regulations, there are still disputes among parties regarding the scope of environmental impact assessment, the formulation of environmental standards, the implementation of environmental management and monitoring plans, and the application of regional environmental management

plans. Strengthening the participation of multiple subjects in the law-making for the deep seabed environmental protection of the ISA will help to promote the consensus of States on adopting precautionary approaches for deep seabed commercial mining governance.

The ISA, sponsoring States, and Contractors have their responsibilities in adopting precautionary approaches to reducing the environmental effects of deep seabed mining. The ISA is the competent international organization for deep seabed mining activities and has the authority to approve mining applications subject to the relevant requirements. Subject to the application of precautionary approaches, the Legal and Technical Committee (LTC) of the Authority will determine whether the proposed work plan is effective in protecting the marine environment and biodiversity. The LTC should ensure that appropriate procedures and the best available scientific and technical information are in place to assess whether the proposed program of work meets the requirement. The application and approval process for developing a work plan requires the Authority to review the detailed environmental impact statement, environmental management and monitoring plan, and closure plan from the Contractor. As part of the overall review of the application, the LTC shall review the application based on the comments from stakeholders and the applicant's responses, and consider whether the plan is effective in protecting the marine environment as well as taking precautionary measures in accordance with Article 145 of the UNCLOS. If the application meets the requirements, LTC will recommend it to the Council for the work plan to be approved. However, the Council will not approve an exploitation application if there is evidence of a risk of serious harm to the marine environment. In addition to approving exploitation applications, the ISA is also trying to establish an environmental compensation fund through the Exploitation Regulations aimed at paying for preventive and restoration measures where the Contractor or sponsoring State is not liable.

The sponsoring States also have obligations to take precautionary approaches. All three exploration regulations stipulate that in order to ensure the effective protection of the marine environment from possible harmful effects of activities in the Area, the Authority and sponsoring States should adopt a precautionary approach as reflected in Principle 15 of the Rio Declaration. Regulation 33 of the Regulations on Prospecting and Exploration for Polymetallic Sulphides in the Area provides that Contractors, sponsoring States, and other interested States or entities shall cooperate with the Authority in the establishment and implementation of programs for monitoring and evaluating the impacts of deep seabed mining on the marine environment. In addition, the application of a precautionary approach is also an integral part of the sponsoring State's obligation of due diligence. As long as there are potential environmental risks in the activities guaranteed by the sponsoring State, even if there is no sufficient scientific evidence to prove it, necessary measures should be taken to fulfill the obligation of due diligence. The Article 194 of the UNCLOS embodies the requirement for States to fulfill their obligations diligently. The application of precautionary approaches is closely related to the duty of diligence. On the one hand, in the absence of sufficient scientific evidence but serious or irreversible risks, the application of a precautionary approach helps to clarify and enrich the content of the due diligence obligation in substance and procedure. On the other hand, the duty of due diligence helps States to resolve disputes over the application of the precautionary approach. Therefore, the sponsoring State involves the application of the precautionary approach when performing both direct obligations and obligation "to ensure".

The Contractor's application for exploration of deep seabed mineral resources can only be carried out after the application is approved, and the exploration contract will generate the exclusive right to explore mineral resources within a certain period in a specific area. Environmental obligations are broader in relation to exploitation than exploration. The Contractor must take the necessary steps to prevent and minimize pollution and other hazards to the marine environment and shall always take precautionary measures. The Contractor shall also cooperate with the Authority to develop and implement a management and monitoring plan for the potential impact of exploitation activities on the marine environment and must submit an annual report to the Authority. In addition, compared

with exploration, Contractors have stricter obligations to protect the environment from exploitation. Each application should include a scientific description of the proposed activities, the possible impacts of the exploitation activities on the marine environment and biodiversity, and a list of recommended measures to reduce and control pollution and other hazards to the marine environment.

The application of the precautionary approach means that necessary measures need to be taken when there are scientific uncertainties, which need to clarify the existing scientific knowledge or information and the limits. Given the current limited scientific understanding of deep sea ecosystems and the environmental impacts of deep seabed mining, the views of recognized experts and scientists are particularly important. The expertise advisory mechanism can be a way to provide the best scientific information and clarify uncertainties. According to Article 165(2)(e) of the Convention and Article 8 of Annex III, independent experts may provide advice on specific matters such as marine environmental protection and data assessment of reserved areas. A disconnect between scientists and other stakeholder groups may result in interactions related to science being abstract, jargon-filled (e.g., ecosystem approach), and unspecific, which can sometimes lead to miscommunication and planning errors. When science is not accessible to seabed mining policymakers, the operationalization of regulation frameworks can be hindered [48]. Additionally, interdisciplinary cooperation is likely to become even more relevant when cumulative impacts are to be considered because deep sea mining will add to existing threats to the marine environment, including temperature increase, acidification, deoxygenation, and fishing [49].

To summarize, the Authority, the sponsoring State, and the Contractor all play an important role in the application of the precautionary approach in deep seabed mining. In addition, relevant scientists and experts also have their unique roles. At present, public consultations are ongoing based on an initial set of ten drafts that pertain to phase one, which ranges from matters relating to environmental management systems, environmental performance guarantees, baseline environmental data, environmental impact assessments, hazard identification, and risk management.

#### *4.2. Improving the Application of Precautionary Approaches in Deep Sea Mining by Multi-Subject Participation*

The ISA, sponsoring States, Contractors, scientists, and experts all play a role in the upcoming governance of deep seabed commercial mining. The implementation of precautionary approaches requires a balance between potentially serious environmental risks, available scientific evidence, and cost-effectiveness. Multi-subject participation is an important factor in applying precautionary approaches, allowing competent international organizations to understand the variety of views and concerns regarding environmental risks and their acceptable levels. ISA can establish greater public participation in the ISA's meetings through providing space in the agendas of Assembly and Council meetings for public input; allowing observers to attend pre-determined portions of Finance Committee and LTC meetings, and encouraging all ISA organs, the LTC in particular, to better engage with external experts and organizations, through requests for advice [50]. ISA can also work to make as much information as public as possible, and use the regulatory control to secure a much larger public take [51]. Strengthening the multi-subject participation in the law-making of the deep seabed environmental protection of the ISA will help to promote the consensus on adopting precautionary approaches for deep seabed commercial mining governance.

##### *4.2.1. Identifying the Scope of Environmental Impact Assessment*

For the ISA, which represents the interests of all mankind, multi-subject participation is very important. As mentioned above, there are differences among States on whether social factors should be considered in the process of environment impact assessment. Environment impact assessment is one of the specific manifestations of precaution. Precautionary decision-making includes consideration of scientific knowledge and the identification and

examination of uncertainties. The precautionary approach is valuable in many stages of both the preparation and evaluation of environment impact assessment. The application of the precautionary approach is by stressing the need to avoid the occurrence of irreversible damage. Seeking alternatives to the proposed action as well as ongoing monitoring and research are also essential components of the precautionary approach. Moreover, where there is a possibility of an adverse effect, the provision of evidence that the nature or extent of this will be acceptable will rest with the operator [52]. Regulation 44 of the draft now establishes that not only the ISA and the sponsoring States but also Contractors must plan, implement, and modify the measures within their competences, for the effective protection of the marine environment from harmful effects, applying the precautionary principle to assess and manage the risk to the marine environment.

The precautionary approach requires considering the capabilities of States and cost-effectiveness requirements, which also means that social factors should be considered together rather than just focusing on environmental impacts. As for assessing the biophysical, social, and other relevant effects of the proposed mining operation, the ISA, Contractors, sponsoring States, and the relevant stakeholders will be involved. The ISA, mining Contractors, and sponsoring States are required to apply a precautionary approach to ensure effective protection of the marine environment from the harmful effects of mining. This requirement entails the implementation of protective measures at an early stage in response to a risk of harm, even if scientific evidence as to the specific harm remains uncertain. These measures must be proportionate to the risk [53]. The ISA is currently discussing the establishment of Impact Reference Zones (IRZ), which are “representative of the environmental characteristics of a particular region to be used for assessing the effect of activities in the region on the marine environment”, as well as Preservation Reference Zones (PRZ), which according to the ISA glossary describe “areas representative of the mine site in which no mining shall occur to ensure representative and stable biota of the seabed in order to assess any changes in the flora and fauna of the marine environment caused by mining activities” [54]. In addition, current regulations of environment impact assessment in the draft are flawed without taking alternatives into account. The environment impact assessment typically includes consideration of viable alternatives, including different project locations, sizes, processes, operating conditions, etc. Applying the precaution for the environmental risks that may arise from specific deep seabed mining activities also needs to take into account alternatives to the activity. The establishment of alternatives will undoubtedly require the participation of Contractors, sponsoring States, the ISA, and relevant stakeholders.

#### 4.2.2. Developing Environmental Standards and Guidelines

Regulation 94 of the draft stipulates that the LTC shall, taking into account the views of recognized experts and relevant stakeholders, make recommendations to the Council on the adoption and revision of standards relating to the conservation of the resources and protection of the marine environment. This means that the draft regulations recognize that in the formulation of environmental standards, in addition to the participation of States in the ISA Council, experts and stakeholders can also participate in the formulation of environmental standards. As for the Contractors who are directly restricted by environmental standards, they often influence the formulation of environmental standards by submitting opinions to their sponsoring States. The views of recognized experts and relevant stakeholders should also be taken into account in the follow-up consultations on environmental standard regulations and the formulation of relevant standards and guidelines. The ISA will need a process to review progress toward its targets by evaluating quantifiable performance indicators. At the global and regional scales, this process should not be left to Contractors, as it may not guarantee that the ISA’s environmental objectives are met, although a compilation of standardized measures from Contractors can inform the progress. Developing overarching goals and objectives may require crossing jurisdictions or sectors and, considering cumulative impacts, could require the ISA to work with other

entities that manage or influence the deep ocean. Additionally, ISA needs to cooperate with the scientific community and other stakeholders, which must develop and implement strategic environmental goals and objectives across mineral resource types and environmental settings. This process will require targets that are measurable through a series of realistic indicators and associated ecological thresholds [55].

#### 4.2.3. Promoting the Implementation of Environmental Management and Monitoring

The precautionary approach is incorporated into the Authority's exploration contracts. The ISA is conducting preliminary work on environmental baselines that will facilitate an ecosystem-based approach. Establishing an environmental baseline makes it easy to understand what biota exists at a particular mining site, what impacts mining will have, and how to minimize and manage those impacts [56]. The standard contractual clauses provided by the ISA state that the Contractor shall take the necessary measures to adopt a precautionary approach to the extent reasonably possible. In the draft regulations, the environmental management and monitoring plan is a necessary condition for the Contractor to apply for exploitation. The Contractor shall also implement and maintain an environmental management system. During the application stage, Contractors need to prepare environmental management and monitoring plans in line with the respective regional environmental management plans. Contractors shall submit an environmental management and monitoring plan, together with an environmental impact statement and closure plan, as part of their work plan to the Authority. Currently, there are differences among various parties on how to specify and implement environmental management and monitoring. The implementation of precaution needs to consider States' capacity. The requirements for a precautionary approach may differ for developed and developing countries. In the future consultations on the draft regulations and related standards and guidelines, it is meaningful to achieve a greater degree of multi-participation and provide space for States or Contractors to decide.

#### 4.2.4. Improving the Application of the Regional Environmental Management Plans

Although it may be difficult in the absence of adequate scientific information on deep sea ecosystems, the main priority remains the definition of conservation objectives. The regional environmental management plan (REMP) is a useful tool aimed at operationalizing the precautionary approach. The Regional Environmental Management Plan for the Clarion-Clipperton Zone reflects the REMP as an application of precaution. The Regional Environmental Management Plan for the Clarion-Clipperton Zone not only covered the exclusive exploration areas of relevant States and reserved areas, but also selected nine areas of particular environmental interest. The Plan stipulates the location, size, characteristics, operational objectives, and monitoring mechanisms of areas of particular environmental interest. The environmental management plan for the Clarion-Clipperton Zone, as adopted by the ISA in 2012, protects approximately 25% of the management area [57]. The goal of the regional environmental management plan is to avoid serious or irreversible damage to important seabed ecosystems caused by deep seabed mining through area-based management tools. The formulation or implementation of regional environmental management plans requires the multi-participation of the ISA, sponsoring States, Contractors, stakeholders, scientists, and experts. Currently, States have different opinions on how to specify the regional environmental management plan in the draft regulations. As a means of area-based management, regional environmental management plans will affect the exploitation activities within its scope, the activities on high seas, and the marine activities of adjacent coastal States. In future consultations on relevant regulations, it is important to strengthen the consideration of opinions from all relevant parties and improve the transparency of regional environmental management plan formulation on the basis of the best available science.

## 5. Conclusions

Taking precautionary approaches is the core of the ecosystem-based management of deep seabed mining and is a legally binding obligation on ISA, States, and Contractors. For controlling and reducing potential adverse effects on the marine environment and biodiversity of the international seabed area caused by deep seabed mining, the draft exploitation regulations take precautionary approaches such as stipulating rules, including environmental standards and guidelines, environment impact assessment, environmental management and monitoring plan, and REMPs. However, there are still obvious differences and controversies about making these rules between States due to limited scientific knowledge and diverse States' interests. Multi-subject participation in the law-making helps to make scientific and legitimate decisions that take into account the interests of all relevant parties, and is conducive to promoting consensus among them. We found that the Authority, the sponsoring State, and the Contractor all play an important role in the application of precautionary approaches in deep seabed mining. In addition, relevant scientists and experts also have their unique roles. The stakeholder engagement and the response mechanism to stakeholder comments and suggestions are needed in the process of environmental rule-making in the exploitation regulations. We suggest that multi-subject participation in the ISA's law-making on taking precautionary approaches to govern commercial deep seabed mining shall be strengthened to identify the scope of environmental impact assessment, develop environmental standards and guidelines, promote the implementation of environmental management and monitoring, and improve the application of REMPs.

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