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DEEP SEABED MINING AND PRECAUTIONARY PAUSE: POSSIBILITY AND LEGAL CHALLENGES

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ABSTRACT:

Critical minerals that are greatly needed for green technology could be found in potentially promising quantities on the seafloor. Nevertheless, there are long-term environmental effects associated with recovering such nature of a resources. This research argues based on international law of the sea which applies normative-legal research method using statutory and conceptual approaches. The main findings of this research reveal that the proponents argue that extracting minerals from the deep sea could be beneficial for the humankind, particularly its reliance on electric vehicles, batteries, and zero-carbon technologies. However, many nations are pushing for a ban or delay on seabed mining due to a lack of international law and knowledge of the full environmental effects. For example, direct harm to marine life, long-term species and ecosystem disruption, economic and social risks, and potential climate impacts that would most likely be permanent It is unclear if the International Seabed Authority (ISA) will approve such a ban, but some scientists believe mining will start soon. Therefore, to continue the exploration of deep seabed mining (DSM), regulations should be drafted in full and transparent including the precautionary approach needs to be implemented to minimize the potential destructive impacts due to the DSM activities.

Keywords; *Deep Seabed Mining, International Seabed Authority, Precautionary Pause.*

A. Introduction

The ocean has an important role in temperature control, absorption of carbon dioxide emissions, and providing other ecosystem services.[1] In addition, the increase in human needs in various sectors is causing the availability of minerals on land to be depleted. Therefore, seabed mining is an alternative to meeting mineral needs. Deep seabed mining (DSM) is extracting mineral deposits from more than 200 meters below sea level, referred to as the deep-sea floor.[2]

[1] Wang, Jinpeng, Wenqi Jiang, Chuanjuan Wang, and Dahai Liu. "Taking Precautionary Approaches to the Governance of Commercial Deep Seabed Mining: Law-Making of International Seabed Authority and Multi-Subject Participation." *Sustainability* 15, no. 8 (2023): 1–17.

[2] International Union for Conservation of Nature (IUCN). "Deep Sea Mining," 2022.

Scientists have discovered several important minerals on the seafloor. For seabed mineral resources in international waters beyond national jurisdiction (referred to as "the Area"), permits are only can be made through the International Seabed Authority (ISA) as established in the "United Nations Convention on the Law of the Sea (UNCLOS) 1982." To date, ISA has examined three types of mineral resources in the seafloor areas of commercial interest, namely:[3]

1) Polymetallic nodules contain high concentrations of manganese, nickel, copper and cobalt. These minerals are widely found in several ocean basins, particularly in the "Clarion-Clipperton Zone (CCZ)" which is an abyssal plain located at depths of 4,000 - 6,000 meters below sea level of the Eastern Pacific Ocean;
2) Polymetallic sulfides, these minerals are widely found in areas of seafloor volcanic activity and are distributed at depths of 1,000 - 4,000 meters below sea level. These mineral deposits are often found close to tectonic plate boundaries where hydrothermal vents release superheated, mineral-rich solutions that cool to form deposits;
3) Cobalt crusts, these minerals are widely found on the sides and tops of seafloor mountains at depths of 800 - 2,500 meters below sea level. These crusts can be up to 25 centimeters thick, but the more mineral-rich deposits are only 10 - 15 centimeters thick.

According to UNCLOS, "Part XI and the 1994 Agreement Relating to the Implementation of Part XI of the UNCLOS 1982 (1994 Agreement)," to evaluate potential environmental impacts of marine mineral exploitation in the Area, ISA has created comprehensive rules, regulations, and recommendations.[4] Even though ISA has been working on the regulation to DSM, it is debatable that to attain a net-zero emission world, there must be a global energy transition and a supply from deep-sea resources. Meanwhile, another argument states that to emphasize the necessity to investigate the unidentified deep-sea ecosystems

[3] Putuhena, Ilham. "Urgensi Pengaturan Mengenai Eksplorasi Dan Eksploitasi Pertambangan Di Area Dasar Laut Internasional (International Seabed Area)." *Rechtsvinding* 8, no. 2 (2019): 168.
[4] International Seabed Authority. "Environmental Impact Assessments," 2024.

before irreversibly destroying them and to conserve the ocean.[5] In that respect, 25 states to date have called for a moratorium or precautionary pause.[6] For example New Zealand, Switzerland, Canada, UK, Mexico, Chile, Costa Rica, Ecuador, Spain, Germany, Panama, Ireland, Brazil, Finland, Portugal, Vanuatu, Dominican Republic, Sweden, Monaco, Kingdom of Denmark, Palau, Fiji, Samo, Federated States of Micronesia, and France.

The precautionary principle must be applied in seabed exploration activities due to seabed mining activities' possible harm or ongoing effects. Several international conventions and treaties contain provisions about the precautionary principle in international law. One such is the precautionary principle outlined in Principle 15 of the "1992 United Nations Conference on Environment and Development (Rio Declaration)."

> "*...where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation*."

The concern arises from irreversible ongoing destructive impact. Furthermore, the global environmental organization Greenpeace has also called for an immediate moratorium or precautionary pause on seabed mining activities given the alarming impacts caused by these activities.[7]

Moreover, the harmful impacts of seabed mining activities have been proven through the practices of countries that have conducted mining activities in their jurisdictions. For example, the Solwara 1 mine in Papua New Guinea resulted in the release of sediment plumes that harmed seabed organisms and ecosystems, and the effects of the activity extended up to 10 kilometers from the mine site.[8] Another example of environmental damage can be seen in the Okinawa Trench

[5] *Ibid*.

[6] Deep Sea Conservation Coalition. "Voices Calling for a Moratorium," 2024.

[7] Greenpeace International. "The Oceans Need a Deep Sea Mining Moratorium, Not Regulations That Allow Destruction," 2023. Available online https://www.greenpeace.org/international/press-release/63549/the-oceans-need-a-deep-sea-mining-moratorium-not-regulations-that-allow-destruction/

[8] Leal Filho, Walter, Ismaila Rimi Abubakar, Cintia Nunes, Johannes Platje, Pinar Gökcin Ozuyar, Markus Will, Gustavo J. Nagy, Abul Quasem Al-Amin, Julian David Hunt, and Chunlan Li. "Deep Seabed Mining: A Note on Some Potentials and Risks to the Sustainable Mineral Extraction from the Oceans." *Journal of Marine Science and Engineering* 9, no. 5 (2021).

exploration drilling project. In this case, host Japan has caused changes to the seafloor as well as the original habitat of seafloor organism.[9]

The international debate has arisen as to whether DSM activities should be subject to a moratorium or precautionary pause until they reach stability in minimizing environmental risks or continue exploration, which aims to exploit marine mineral resources to help facilitate the low-carbon energy transition. On the other hand, DSM also faces several legal challenges due to gaps in international law, regulatory uncertainties, and conflicting interests among stakeholders. For instance, lack of comprehensive international regulation as seen in UNCLOS which provides a framework but no further regulations related to legal protection and benefit sharing. Besides, ISA is developing the Mining Code, a set of governing rules of DSM, but until now the Mining Code has not been fixed which causes uncertainty about the legal framework.

Ensuring equitable sharing of benefits, especially for developing nations is a major challenge in implementing DSM. There is still no clear framework for how royalties or benefits sharing from DSM should be allocate to ensure fairness. Furthermore, legal frameworks for precautionary principle are not uniform or comprehensive, making it difficult to assess and mitigate DSM's environmental risks. Considering the impacts that will appear from DSM activities, the novelty of this research will provide significant reasons for whether a precautionary pause is needed in the DSM.

B. Research Method

The research method that will be used in this journal is normative legal research that examines the rules or norms contained in positive law.[10] This research approach applies a statutory approach and a conceptual approach. The statutory approach is carried out by examining the rules in applicable international law of the sea, such as UNCLOS, 1994 Agreement, and ISA Authority. The conceptual approach is carried out by studying the views and doctrines that have developed in the deep seabed mining, such as common heritage of mankind.

[9] Motoori, Ran, and Benjamin C. McLellan. "Resource Security Strategies and Preferences for Deep Ocean Mining from a Community Survey in Japan." *Marine Policy* 128 (2021):1 – 12.

[10] Ibrahim, Johnny. *Teori dan Metodologi Penelitian Hukum Normatif*. Malang: Bayumedia, 2013.

The legal material collection technique used is library research. Literature study is carried out by reviewing and studying laws and regulations, books, reports, or other research results that are relevant to the problem under study.[11]

C. Discussion

DSM poses significant environmental, economic, and socio-cultural impacts that underscore the urgency of implementing a precautionary pause. Environmentally, DSM threatens marine ecosystems through habitat destruction, sediment plumes, and pollution, with irreversible consequences for biodiversity and carbon sequestration. Economically, while DSM has the potential to supply critical minerals for green technologies, it raises concerns about fair benefit-sharing especially for developing nations. Socio-culturally, DSM risks damaging underwater cultural heritage and disregards the spiritual and ecological connections of indigenous communities to the ocean. The precautionary pause would provide time to address these uncertainties, develop robust legal frameworks, conduct comprehensive environmental impact assessments, and foster international cooperation to ensure DSM activities are equitable and sustainable.

1. Impacts of Deep Seabed Mining

a. Environmental Impacts

There are innumerable ways that deep-sea mining could affect the ecosystem. All states agree to comply with Article (Art.) 145 of the UNCLOS, which outlines necessary steps to ensure efficient maritime environment protection against detrimental activities in the Area. Firstly, seabed disruption because machine-induced excavation and ocean floor gauging can change or even wipe out deep-sea ecosystems. It is the most noticeable consequence of DSM, and the damage is probably irreversible.

Secondly, sediment plumes because of the DSM activities. Scientists are concerned about particles because DSM activities could disperse for hundreds of kilometers, disrupting ecosystems

[11] Marzuki, Peter Mahmud. *Penelitian Hukum*. Jakarta: Kencana, 2017

and vulnerable or economically significant species.[12] Thirdly, pollution caused by the DSM activities could affect species such as whales, tuna, and sharks due to the noise, vibrations, and light pollution based on mining equipment and surface vessels, as well as potential leaks and spills of fuel and toxic products.

b. Economic Impacts

"*The Area and its resources are the common heritage of mankind*" – Art. 136 of the UNCLOS

Activities in the Area shall be carried out in such a manner as to foster healthy development of the world economy and balanced growth of international trade, and to promote international cooperation for the overall development of all countries, especially developing States." – Art. 150 of the UNCLOS

Pro-DSM businesses, organizations, and governments will always claim that DSM is necessary to protect our way of life and advance the quickly developing field of green technology. Additionally, they will contend that DSM may offer financial and economic advantages to the global community.[13] Considering the original moulds of the so-called parallel system, which aimed to serve the interests of all people, this might be true. However, the 1994 Agreement altered the original moulds of the parallel system, rendering these strategic metals unattainable to those needing more technology to pursue them. This made it hard for them to reap the benefits of their newfound resources.[14]

Furthermore, others say that DSM has to be done since the economic impact outcomes are projected to be generally better when generating metals from nodules.[15] In addition, seabed mining

[12] Lusty, PAJ, DOB Jones, D Diz, JM Durden, HLJ Grant, and Josso P. "Deep Sea Mining Evidence Review ," 2021.

[13] Wilde, Daniel, Hannah Lily, Neil Craik, and Anindita Chakraborty. "Equitable Sharing of Deep-Sea Mining Benefits: More Questions than Answers." *Marine Policy* 151 (2023): 1 – 12.

[14] Kim, Rakhyun E. "Should Deep Seabed Mining Be Allowed?" *Marine Policy* 82 (August 2017): 134–37

[15] Miller, KA, K Bridgen, D Santillo, D Currie, P Johnston, and KF Thompson. "Challenging the Need for Deep Seabed Mining from the Perspective of Metal Demand, Biodiversity, Ecosystems Services, and Benefit Sharing." *Frontiers in Marine Science* 8 (July 2021): 1–7.

expenditures are perceived to be lower prices than land mining. Still, it is unlikely that land mining will be replaced by seabed mining. Since the mineral resources in the Area are considered the common heritage of mankind, a fair compensation scheme for these resources must be devised. At this point in the negotiations, the main points of discussion are the topic of fairness by using an effective tax rate and charging them the same total amount of taxes as mining on land.[16]

c. Socio-Culture Impacts

"*Activities in the Area shall be carried out for the benefit of mankind as a whole*." – Art. 140 of UNCLOS

"*All objects of an archaeological and historical nature found in the Area shall be preserved or disposed of for the benefit of mankind as a whole*." – Art. 149 of UNCLOS

Although socio-cultural matters are not extensively covered by UNCLOS rules, in the decades that have followed the Convention's adoption, significant attention has been paid to these considerations. These involve discussions with representatives of indigenous peoples. Indigenous Peoples frequently emphasize the need of taking into account their deep spiritual ties to the ocean and the knowledge they have gathered over many generations, which should guide decision-making.[17] Such discussions are often reflected in the negotiations on underwater cultural heritage, particularly when determining which aspects are tangible and which are not. While some frequently highlight pertinent UNCLOS provisions—such as Art. 149—as the foundation for obligations, others emphasize the necessity of approaching the issue of underwater cultural heritage from a more comprehensive angle. In

[16] Almeida, Laisa Branco de. "Ocean Law In Times Of Health Emergency: Deep Seabed Mining Contributions And Its Fear of Overexploitation," *Indonesian Journal of International Law* 18, no. 1 (2020): 1–22.

[17] Earth Negotiations Bulletin. "Summary of the Twenty-Eighth Annual Session of the International Seabed Authority (Third Part): 30 October – 8 November 2023" 25, no. 254 (2023): 1–17.

this regard, they highlight the necessity of indigenous peoples playing a more active role in the negotiations.

2. Legal Considerations

There are still no rules regulating commercial DSM in international waters. Nevertheless, since the beginning of July 2023, applications to mine deep-sea minerals can now be submitted to the ISA. In this sense, the ISA ensures that work plans for exploring and exploiting deep-sea mineral resources abide by relevant environmental laws and UNCLOS provisions.[18] In practice, ISA has been working with the Mining Code within the general legal framework established by "UNCLOS," particularly "Part XI on the Area and the 1994 Agreement." By this, ISA has made several regulations and recommendations to govern matters relating to seabed mineral exploration in the Area, such as "Exploration for Polymetallic Nodules (2000 and revised in 2013), Exploration for Polymetallic Sulphides in the Area (2010), and Exploration for Cobalt-rich Ferromanganese Crusts in the Area (2010)."

The Parties must submit to the ISA for approval of a work plan before they can get an exclusive 15-year right to explore the Area. Art. 145 of the UNCLOS, ISA is responsible for protecting the marine environment from any negative impacts that can result from activities taking place inside the Area.[19] In fulfilling this mandate, "The Legal and Technical Commission (LTC)" provides the Council and Assembly of ISA with professional advice and recommendations to help them. Based on Art. 165 of the UNCLOS, the LTC is authorized to draft evaluations of the environmental effects of operations within the Area and recommend to the Council measures to preserve the marine environment while considering the opinions of acknowledged specialists.[20]

[18] Bräger, Stefan, Gabriela Q Romero Rodriguez, and Sandor Mulsow. "The Current Status of Environmental Requirements for Deep Seabed Mining Issued by the International Seabed Authority." *Marine Policy* 114 (2020): 1 – 8.

[19] Singh, Pradeep A. "The Invocation of the 'Two-Year Rule' at the International Seabed Authority: Legal Consequences and Implications." *International Journal of Marine and Coastal Law* 37, no. 3 (2022): 375–412

[20] Sun, Linlin. International Environmental Obligations and Liabilities in Deep Seabed Mining. Cambridge: Cambridge University Press, 2023.

It is undeniable that the seabed in the Area is full of resources. However, DSM will be exempted from "environmental impact assessment (EIA)" measures established based on the landmark of the international ocean treaty or High Seas Treaty.[21] The treaty provides an extensive range of options for ocean science research, capacity building for research in low- and middle-income nations, and enhancing the knowledge available to policymakers. When using marine genetic resources, researchers must register their interests with a central clearinghouse and pledge to publicly make study outputs and data available.[22]

The High Seas Treaty is establishing the legal framework for the future establishment of marine protected areas and additional finance mechanisms for marine conservation. Environmentalists fear that this might undermine efforts to protect the seafloor from human activities, for which present EIA rules are not very comprehensive, as they do not include all the essential features of an effective EIA regime. That being said, there appears to be a great deal of uncertainty and discretion for contractors consisting of objective evaluation standards and thresholds to apply when assessing and making choices based upon an "environmental impact statement (EIS)".[23]

The agreement is crucial because it acknowledges the significance of marine biodiversity concerning the Area and the high seas. To be legally enforceable, the agreement must first be formally adopted and then ratified by a sufficient number of individual countries. The parties will then meet to develop the legal framework into an actionable plan. Its implementation in concrete will require further development in the future. As a result, numerous governments have called for a moratorium or a precautionary pause, as detailed in the following paragraph.

[21] Civillini, Mateo. "High Seas Treaty Exempts Deep-Sea Mining From Stricter Environmental Rules." Climate Home News, March 8, 2023.

[22] Rabone, Muriel, Harriet Harden Davies, Jane Eva Collins, Sabine Zajderman, Ward Appeltans, Gabi Droege, Angelika Brandt, et al. "Access to Marine Genetic Resources (MGR): Raising Awareness of Best-Practice Through a New Agreement for Biodiversity Beyond National Jurisdiction (BBNJ)." *Frontiers in Marine Science* 6, no. 520 (2019): 1–22.

[23] Singh, Pradeep A. "A Reflection of the EIA Process for Exploration Activities at the International Seabed Authority in Light of the Recent NORI EIS." DSM Observer, December 20, 2022.

3. The Urgency of Precautionary Pause

a. Defining the Precautionary Principle

The controversy arises because there are two sides to the debate. The parties who support commercial exploitation of mineral resources from the seabed in the Area (the proponents) and those who advocate for a moratorium or precautionary pause to gather the necessary scientific knowledge to ensure the marine environment's effective protection before determining exploitation regulations (the opponents). The precautionary principle promotes deferring potentially harmful decisions and taking proactive measures to limit risks.[24] Trouwborst offers the most thorough analysis, breaking down precaution into three main categories, namely:[25]

1) Threat of Environmental Harm

The prospect of environmental harm prompted the development of the precautionary approach. Despite the promising aspects of DSM, the world faces opposition driven by concerns over environmental harm and inherent uncertainty associated with DSM. Though researchers credit the potential value of the DSM industry, they underscore the need for proper technology and regulations to prevent harm to marine life and ecosystems.[26]

2) Uncertainty

Various international instruments have different thresholds for the probability of harm; some only require the potential that harm might, may, or could occur. Trouwborst conducted a thorough examination and concluded that, for customary law to apply, there must be "reasonable grounds for concern," or more

[24] Hyman, Jayden, Rodney A Stewart, and Oz Sahin. "Adaptive Management of Deep-Seabed Mining Projects: A Systems Approach." *Integrated Environmental Assessment and Management* 18, no. 3 (2021): 674–81.

[25] Trouwborst, Arie. Evolution and Status of the Precautionary Principle in International Law. Boston: Kluwer Law International, 2002.

[26] Sharma, Rahul. "Deep-Sea Mining: Current Status and Future Considerations." In Deep Sea Mining, 1–21. India: Springer International Publishing, 2017.

than just a theoretical possibility but "less than proof of probability of harm," that environmental harm may occur.

3) Action

Early remedial action is the third and most important component of precaution. The two fundamental requirements need to be emphasized. The first and most important requirement for preventative measures is their effectiveness. The goal is to design policies that are flexible enough to accommodate modifications as and when new information becomes available and detailed enough to be understandable and significant. Second, proportionality: the degree of protection that a preventative measure must match.

b. The Proponents

The proponents of DSM argue that their technology can contribute to meeting the world's urgent demand for essential minerals. According to estimates, as the world becomes more dependent on renewable energy sources, the demand for some of these minerals might climb by as much as 400%–600% in the ensuing decades. For example, it is anticipated that Nauru, a small nation of Pacific Islands, will be the first to apply to the ISA to start mining on behalf of Nauru Ocean Resources Inc., a subsidiary of "The Metals Company (TMC)." When Nauru announced its plan to do so in 2021, it opened the door to the so-called "two-year rule" loophole, which allowed it to begin exploitation operations this year even though the mining code was still incomplete.[27] China is a leading proponent of deep-sea mining; three companies, including the state-owned Minmetals group, presently possess ISA-issued exploration licenses. China's interest in DSM is driven by the potential for accessing critical minerals, which are important for green and renewable energy technologies, as well as for military

[27] Roland Holst, Rozemarijn J. "Exploiting the Deep Seabed for the Benefit of Humankind: A Universal Ideology for Sustainable Resource Development or a False Necessity?" *Leiden Journal of International Law*, (2023): 1–23.

and aerospace applications. China's Central Military Commission has identified the deep sea as a new battlefield, and the research needed for deep-sea mining is also relevant for military purposes.

c. The Opponents

The opponents of DSM argue that the DSM industry is the next great threat to our ocean.[28] Finland has taken a step forward at the ISA Council meeting regarding precautionary pause initiatives. On March 20, the Finlandia delegation at the ISA demanded that seabed exploitation cease until strict environmental regulations are in place and stressed the need for additional scientific research.[29] The current leader of the seabed authority's governing council, Chile, has proposed delaying a mining code agreement for 15 years to do additional research on the consequences of ocean floor excavation. Brazil, the Netherlands, Portugal, Singapore, Ecuador, Italy, and Switzerland have all supported it and said they will not accept mining contracts unless sufficient environmental measures are in place.

Furthermore, from October 31 to November 11, 2022, the German government declared that it will not accept any proposals for deepwater commercial raw material mining until further notice. Research and understanding now available are insufficient to rule out the possibility that seabed mining operations will cause significant environmental harm.[30] International opposition to the DSM continues to grow. For example, a lot of firms, like automakers, Google, Samsung, and Ecoctricity, have committed to not using minerals that are mined in the ocean.

[28] Hallgren, Axel, and Anders Hansson. "Conflicting Narratives of Deep Sea Mining." *Sustainability* 13, no. 9 (2021): 1–20.

[29] Seas at Risk. "Finland Joins EU Countries Calling for a Precautionary Pause of Deep-Sea Mining," March 21, 2023.

[30] German Marine Research Consortium. "German Government Calls For 'Precautionary Pause' and More Intensive Research Into Environmental Impacts," November 30, 2022.

d. Possibility of Precautionary Pause

Under international environmental law, the precautionary approach is a fundamental and well-established notion.[31] Assessing the possibly detrimental consequences and the dangers provided by incomplete knowledge and uncertainty is necessary to determine whether preventive measures are needed for DSM.[32] Scientific research, nevertheless, indicates that seabed mining activities may have significant adverse effects on the marine environment and ecosystems. Preventive measures should be effective and proportionate to the goals and objectives so that they are no more restrictive than is necessary.[33]

To determine the much-needed precautionary pause, the policymakers assess whether scientific evidence supports probable effects and, if so, whether such harms are severe or irreversible. If the response is affirmative, the precautionary approach should be applied.[34] The majority of exploitation and certain exploration operations have the potential to seriously or irreversibly harm people. The amount of harm considered acceptable and protection considered necessary determine the right amount of precaution.

D. Conclusion

The scientific uncertainties surrounding the potential environmental impacts of DSM present significant challenges and trigger an obligation to apply the precautionary principle. DSM will hurt the environment. Moreover, individuals may be impacted by DSM through direct, indirect, or combined effects with other pressures brought on by humans, such as climate change. However, it is feasible that DSM might be a source of financial and commercial benefits for the

[31] Gill, Gitanjali Nain. "Recautionary Principle, Its Interpretation and Application by the Indian Judiciary: 'When I Use a Word It Means Just What I Choose It to Mean-Neither More nor Less' Humpty Dumpty." *Environmental Law Review* 21, no. 4 (2019): 292–308.

[32] Durden, Jennifer M, Laura E Lallier, Kevin Murphy, and Aline Jaeckel. "Environmental Impact Assessment Process for Deep-Sea Mining in 'the Area'." Marine Policy, 83 (2018):194-202.

[33] Makgill, Robert, Aline Jaeckel, and Keith Macmaster. "Implementing the Precautionary Approach for Seabed Mining: A Review of State Practice." In Routledge Handbook of Seabed Mining and the Law of the Sea, 1st ed. London: Routledge, 2023.

[34] Pacific Possible. "Precautionary Management of Deep Sea Minerals." USA, June 30, 2017.

international community with discoveries, particularly biological, particularly in the field of biology, as significant technological developments in the exploration process in DSM support it. Addressing these knowledge gaps requires basic knowledge of the environmental baseline and potential non-mining impacts such as climate change. The precautionary pause or moratorium is the main alternative as it consists of a legally defined delay period in which there is a suspension or prohibition of DSM until certain objectives have been met. This action will give the international community more time to create a strong legal framework. Considering everything, the proponents should not be forced to refute a risk assertion in the lack of supporting data.

E. Suggestion

The impacts of DSM will affect many marine environments across jurisdictions for both short and prolonged periods in the grander development scheme. As the most authoritative organization in DSM activities, the ISA ought to promote multi-subject involvement in enacting laws pertaining to adopting preventive measures to regulate commercial DSM. Given the obstacles that the ISA is now facing in implementing a cautious approach, several steps might be taken to better match the precautionary approach's criteria with the ISA's regulatory framework. Firstly, an international moratorium should be implemented, along with definite inducement to do scientific study in marine sciences. The aim would be to decrease scientific uncertainty about deep-sea mining. Secondly, fixed Mining Code, strengthen the regulations to identify the scope of EIA, develop environmental standards and guidelines, support the implementation of environmental management and monitoring, and ensure legal protection of the marine environment. Finally, the international dialogue, enhancing the international dialogue discussing deep-sea, should raise awareness as we deal with an interconnected ecosystem.

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