

UNCHARTED WEALTH AND RISKS: LEGAL ANALYSIS OF DEEP-SEA MINING FOR ECONOMIC AND SOCIAL WELFARE

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Abstract

Indonesia has the potential to become an economic powerhouse, with rich resources on land and at sea. The country's marine coastline is rich in natural resources such as minerals, oil, and coal, all of which are necessary for industrial growth. Deep-sea mining, in particular, is gaining popularity due to the enormous unexplored riches beneath the ocean bottom. However, this business is immensely divisive. Proponents say that deep-sea mining can boost national economic growth and bring up new industrial opportunities. Opponents are concerned about the environmental harm it may create. This argument raises serious concerns regarding the ethics and sustainability of deep-sea mining. To address these concerns, this study will examine both sides of the debate and offer solutions for sustainable deep-sea mining techniques.

Keywords: Deep-sea mining, environmental damages, economic growth, social welfare, natural resources.

A. Introduction

Indonesia is a vast archipelagic country with abundant resources in both terrestrial and marine sectors. As land resources decrease, attention has increasingly turned to the potential source of the marine industry, particularly sea-bed mining for industrial sustainability. Large amounts of resources such as coals and minerals are predicted to be found in the sea.⁴ In 2021, the recorded data stated that there were 2,611 metallic minerals, 4,270 nonmetallic minerals and rocks, 1,567 coals, and 70 coal-bed methane.⁵ It is an advantage for Indonesia's economy, considering that Indonesia has a large scope of sea area. Unfortunately, the utilization of the marine sector is still not optimally tapped despite the huge potential of maritime resources. It needs to be balanced by qualified and competent human resources, technologies, regulations, and implementations.⁶

In recent years, there have been indications of industrial growth, in both private and public corporations. Some corporations, such as Pertamina, are conducting further underwater exploration, an activity that is also known as marine exploration. This can be derived from several reasons, one of which is the rising price of metal that can be seen from several sea mining

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⁴ Ministry of Energy and Mineral Resources Republic of Indonesia Geological Agency, "Minerals, Coal, And Geothermal Resources And Reserves 2021," (Indonesia: Ministry of Energy and Mineral Resources Republic of Indonesia Geological Agency, 2021), hlm. i.

⁵ *Ibid.*

⁶ Anne-Sophie Martin, "Spaceports on Coastal Areas and Spaceflights: Legal Considerations on the Protection of Marine Environment," *Maritime Safety and Security Law Journal*, no. 13 (2023): 1–20.

explorations, currently being carried out. For example, other countries such as Norway have passed a bill regarding sea mining in search of precious metals.⁷ Canada, on the other hand, has already prepared a company specialised in deep-sea mining, The Metals Company, to start production, which is expected in the fourth quarter of 2025.⁸ This shows that other countries have spearheaded deep-sea mining initiatives in response to the global demands of modern industries that require minerals. Though the profits that will be obtained can be promising, sea exploration has given rise to some controversy in different aspects. The sea explorations, through corporations, have created an issue encompassing various elements such as legal ambiguities, social impacts, environmental sustainability, and economic viability.⁹

Deep-sea mining is the process of extracting precious minerals from the ocean floor, which can be hundreds or thousands of meters below the surface.¹⁰ It covers discovering and extracting non-living resources such as minerals (sand, gravel, tin, and diamonds), and offshore oil and gas. These resources are often located within 200 nautical miles off the shore, with oil and gas extracted from waters less than 100 meters deep.¹¹ Given the limited areas explored and studied, deep-sea mining represents a highly promising industry with lots of resources. Based on the research, mineral deposits, oil, and coal resources are easy to find in three locations; the abyssal plains, seamounts, and hydrothermal vents.¹² These three areas are the primary targets of deep-seabed mining (DSM), with attention focused on the Clarion Clipperton Zone (CCZ). This promising potential, however, also raises a complex collection of concerns and debates.

Deep-sea mining is a controversial issue, dividing opinions between those who see its economic potential and those who fear ocean degradation.¹³ Proponents argue that seabeds hold valuable resources, with demand for minerals like lithium and graphite, potentially rising by 400%-600% globally, making the ocean the new “gold rush.”¹⁴ Therefore, this perspective sees seabeds as a major untapped resource that can alleviate the pressure for terrestrial nonrenewable

⁷ Esme Stallard, “Deep-Sea Mining: Norway Approves Controversial Practice,” [www.bbc.com](https://www.bbc.com/news/science-environment-67893808), January 9, 2024, <https://www.bbc.com/news/science-environment-67893808>, accessed on July 19, 2024.

⁸ Cecilia Jamasmie, “Canadian Deep-Sea Miner TMC to Seek Licence in 2024,” [mining.com](https://www.mining.com/canadian-deep-sea-miner-tmc-to-seek-licence-in-2024/), August 3, 2023, <https://www.mining.com/canadian-deep-sea-miner-tmc-to-seek-licence-in-2024/>, accessed on July 19, 2024.

⁹ Priyanka Runwal, “The Deep-Sea Mining Dilemma,” [Chemical & Engineering News](https://cen.acs.org/environment/water/deep-sea-mining-dilemma/101/i33), October 9, 2023, <https://cen.acs.org/environment/water/deep-sea-mining-dilemma/101/i33>, accessed on July 19, 2024.

¹⁰ Oliver Ashford, *et al.*, “What We Know about Deep-Sea Mining—and What We Don’t,” [World Resources Institute](https://www.wri.org/insights/deep-sea-mining-explained), July 19, 2023, <https://www.wri.org/insights/deep-sea-mining-explained>, accessed on July 19, 2024.

¹¹ Advisory Committee on The Protection of The Sea, “Deep Seabed Mining (WG7)—Advisory Committee on the Protection of the Sea,” [acops.org.uk](https://www.acops.org.uk/deep-seabed-mining-wg7/), <https://www.acops.org.uk/deep-seabed-mining-wg7/>, accessed July 20, 2024.

¹² Michelle Logan, “Deep Seabed Mining,” [The Ocean Foundation](https://oceanfdn.org/deep-seabed-mining/), August 7, 2010, <https://oceanfdn.org/deep-seabed-mining/>, accessed July 20, 2024.

¹³ Justin Rowlatt, “Greenpeace Could Be Thrown out of UN Deep-Sea Mining Body,” [bbc.com](https://www.bbc.com/news/science-environment-68576735), March 18, 2024, <https://www.bbc.com/news/science-environment-68576735>, accessed July 20, 2024.

¹⁴ Oliver Ashford, *et al.*, “What We Know about Deep-Sea Mining—and What We Don’t,” [World Resources Institute](https://www.wri.org/insights/deep-sea-mining-explained), July 19, 2023, <https://www.wri.org/insights/deep-sea-mining-explained>, accessed July 19, 2024.

resources. Although this promising industry is starting to be looked at more closely, we lack the scientific knowledge to comprehend and control mining's consequences on deep pelagic ecosystems, which make up the majority of the biosphere.¹⁵

Conversely, environmentalists worry about the potential damage that can highly change the ecosystem and lead to ecological damage. Instances like the oil spill on the Batam coast contaminated the coastal ecosystem and impacted local communities due to an oil spill that was said to be from a tanker that caught fire in Malaysia.¹⁶ This toxication from such mining incidents can be seen as the risks that could happen with deep-sea mining. The absence of specific regulations on seabed mining in Indonesia exacerbates these concerns, leading to disagreements about its feasibility and safety. Currently, Indonesia depends on international maritime law, which focuses on fishing rather than seabed mining, resulting in legal uncertainties and enforcement issues.¹⁷ Without explicit national legislation, the balance between commercial interests and environmental preservation is difficult.¹⁸

Based on this topic, the purpose of this article is to examine the problems and regulations regarding deep-sea mining or other marine exploitations. The study will include both national and international views to ensure a thorough understanding of the issue. The paper will focus on legal aspects, serving as the framework for its analysis. It will combine theoretical frameworks with the current conditions in Indonesia to give comprehensive and systematic solutions to deep-sea mining activities such as making it accessible or publicly available while binding each party stated in the regulation fairly. It will break down the elements needed in the regulation to ensure the protection of the environment while maximizing the use of resources in Indonesia. Furthermore, this article intends to provide suggestions for expanding the maritime industry within certain environmental constraints such as protecting the marine ecosystem's biodiversity and strict waste management for the economic and social welfare of the country.

Deep-sea mining offers staggering economic and social prospects for Indonesians, yet the lack of regulations and control might cause marine ecosystems and environmental damage. Based on Article 1 Number 28 Letter a of Law No.3 Year 2020, which amends Law No. 4 Year 2009 regarding Minerals and Coal Mining, it states that sea areas or marine regions are included

¹⁵ Jeffrey C. Drazen et al., "Opinion: Midwater Ecosystems Must Be Considered When Evaluating Environmental Risks of Deep-Sea Mining," *Proceedings of the National Academy of Sciences* 117, no. 30 (July 28, 2020): 17455–60.

¹⁶ Fadli Jakarta Post, "Oil Spills Hit Batam Coast - Archipelago," *The Jakarta Post*, May 4, 2023, <https://www.thejakartapost.com/indonesia/2023/05/04/oil-spills-hit-batam-coast.html>, accessed on July 31, 2024.

¹⁷ Chuanliang Wang, Qian Zhao, and Yen-Chiang Chang, "On the Legal Status of Marine Fishery Resources: From the Perspectives of International Fishery Law," *Heliyon* 9, no. 4 (April 1, 2023): e15354–54.

¹⁸ Marta Conde, *et.al.*, "Mining Questions of 'What' and 'Who': Deepening Discussions of the Seabed for Future Policy and Governance," *Maritime Studies* 21, no. 3 (July 3, 2022): 327–38.

in the mining zones.¹⁹ This statement sparked questions about whether Indonesia had allowed mining on its seafloor.²⁰ The absence of a particularized regulation of deep-sea mining forces Indonesia to follow international conventions and treaties, which are not always followed adequately. However, this statement is insufficient to address the issue regarding deep-sea mining, which is a complex matter that requires extremely extensive regulation. If not properly regulated, the objective of deep-sea mining may counteract the primary goal of social and economic welfare. Fishermen who rely on fishing for their income, are threatened by the potential ecosystem degradation following the appearance of deep-sea mining.²¹ In addition, incidents of oil spills in the ocean also led to skepticism concerning the feasibility of deep-sea mining as oils contain dangerous chemical substances that can kill fish. This results in adverse effects on social welfare, as many citizens rely on fish as a source of food.²²

B. Research Method

The research method that is used for this paper is qualitative research methodology. Qualitative research methodology is a methodology that examines the opinions, behaviors, theories, and experiences of people. In this method, it collects and analyzes an issue with words and textual data. The specific qualitative research methodology for this paper is focused on a document study known as a literature review and normative methods. The research will be based on a review of already existing written materials such as archives, annual reports, research articles, guidelines, policy documents, etc.

Using literature review as the method is due to the condition that only a few people specify to lecturers, legal practitioners, and governments that study the law of the sea. It is seen from the minimum regulations about the marine sector, especially for deep-sea mining. The government does not make regulations or specific rules yet for the marine sector as it should be part of environmental law. However, experts such as Mahan Alfred Thayer and Geoffrey Till have presented their theories about securing the maritime environment.²³ Deriving from these factors, research using literature review methods would be suitable for the paper.

¹⁹ Indonesia, Law No. 3 Year 2020 amended by Law No. 4 Year 2008 regarding Minerals and Coal Mining, article 1 number 28(a).

²⁰ Evan Tobias, "Commencing Deep Seabed Mining: A Review on Law No. 3 of 2020 on Mineral and Coal Mining," *Brawijaya Law Journal* 9, no. 1 (April 30, 2022): 59–75.

²¹ Tirta Anugerah, Arya Hadi Dharmawan, and Ivanovich Agusta, "Dampak Penambangan Timah Laut Terhadap Sumber Penghidupan Rumah Tangga Nelayan Di Kabupaten Meranti," *BHUMI: Jurnal Agraria Dan Pertanahan* 7, no. 1 (June 14, 2021): 112–25.

²² *Ibid.*

²³ Ferdy Leorocho, *et.al.*, "Comparative Study on Maritime Security Theory of Mahan Alfred Thayer and Geoffrey Till on the Strategic and Practical Implications of Constructing a Sea Defense," *International Journal of Progressive Sciences and Technologies (IJPSAT)* 38, no. 1 (April 1, 2023): 456–464.

1. Hypothesis

- a. Research Hypothesis: It is hypothesized that effective regulation and systematic boundaries optimize the utilization of seabed resources with the expected outcomes outlined in the forms of acts, government regulations, and ministerial regulations that are publicly accessible and cover the important aspects of all relevant parties appropriately .
- b. Discipline: Law and Environmental Studies
- c. Hypothesis as Question: Are the current laws and their implementation effective in supporting the marine sector, specifically deep-sea mining, in Indonesia?

2. Advantages of the Research

- a. The research paper will help to provide a more thorough understanding of the maritime law issue in Indonesia.
- b. The research paper will help to provide suggestions for ways to increase maritime security.
- c. The research paper will help in giving understanding and consideration for protecting the environment from damage by analyzing the situation of deep-sea mining and its difficulties, presented in the paper.

C. Analysis

1. Legal Frameworks Governing Deep-sea Mining

In regards to protecting the marine ecosystem, a regulation should be precautionary.²⁴ Each step must contain a procedure to manage the environment, as in the real action to prevent environmental damage and reduce biodiversity loss. By implementing regulation, the miners and manufacturers are given responsibility for their minerals sourcing.²⁵ The difficulty might derive from the complexity of the ocean's resources, which is sometimes deemed more than exploring the moon.²⁶ The creation of regulation needs to measure the potential exploitation of deepsea mining by national and international officials.

Deep seabed mining in Indonesia is controlled by a mix of international and national regulatory frameworks that aim to ensure responsible use of marine resources while protecting

²⁴ European Academies' Science Advisory Council, "Deep-Sea Mining: Assessing Evidence on Future Needs and Environmental Impacts Contents," June 8, 2023.

²⁵ World Economic Forum, "Decision-Making on Deep-Sea Mineral Stewardship: A Supply Chain," World Economic Forum, April 12, 2022, www.weforum.org/publications/decision-making-on-deep-sea-mineral-stewardship-a-supply-chain-perspective/.

²⁶ Egorov, L. et al., "Sustainable Seabed Mining : Guidelines and a new concept for Atlantis II Deep," The LRET Collegium Series: Seabed Exploitation 4, 2012.

the environment and social welfare. At the international level, the United Nations Convention on the Law of the Sea (UNCLOS) provides a legal foundation for all ocean operations, including seabed mining.²⁷ It establishes nations' rights and obligations while exploiting maritime resources and lays the groundwork for sustainable practices. In addition to UNCLOS, the International Seabed Authority (ISA) is responsible for regulating mineral-related operations in international seabed areas.²⁸ The ISA laws describe specific processes for exploration and exploitation, with an emphasis on environmental conservation and equitable profit sharing. These regulations also mandate Environmental Impact Assessments (EIAs) and establish technological, financial, and safety standards for mining operations.

Nationally, Indonesia has enacted a few sets of laws to manage its maritime and mining activities though not specifically regarding deep-sea mining. Law No. 32 Year 2014 on Marine Affairs controls the country's sovereignty over its territorial seas, exclusive economic zones (EEZ), and continental shelf, outlining the limits of state power in regulating seabed mining operations. Furthermore, Law No. 17 Year 1985 incorporates UNCLOS requirements into Indonesian legislation, assuring conformity with international commitments. Environmental protection is handled by Law No. 32 of 2009 on Environmental Protection and Management, which establishes standards for EIA's and marine conservation measures, and Government Regulation No. 21 Year 2021, which specifies the processes for conducting EIA's and managing environmental consequences.²⁹ In mining, Law No. 4 of 2009 on Mineral and Coal Mining governs the exploration, exploitation, and management of mineral resources, including those on the seabed, while Government Regulation No. 23 the Year 2010 specifies licensing procedures, safety standards, and environmental management in mining operations.³⁰

Despite somewhat thorough legal frameworks, there are still significant loopholes and issues in Indonesia's regulations. One key concern is the need for improved alignment between ISA rules and Indonesian state legislation to guarantee that seabed mining activities are managed seamlessly. This involves coordinating environmental standards and procedural procedures between the government, society, and corporations to prevent legal ambiguity and enforcement issues that occur in the cooperative process. Furthermore, existing environmental legislation may fail to adequately address the unique effects of deep-sea mining. There is an urgent need for

²⁷ United Nations Convention on the Law of the Sea, (Adopted 30 April 1982, enters into force on 16 November 1994).

²⁸ Klaas Willaert, "Regulating Deep-sea Mining" (Springer Nature, 2021).

²⁹ *Undang-Undang (UU) Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup*, Law No. 32 Year 2009, LN Year 2009 No. 140 TLN No. 5059.

³⁰ *Undang-Undang (UU) Nomor 4 Tahun 2009 tentang Pertambangan Mineral dan Batubara*, Law No. 4 Year 2009, LN Year 2009 No. 4, TLN No. 4959.

tailored rules, like the international conventions and national regulations, that take into account the distinctive ecosystems and probable long-term impacts of mining operations on marine biodiversity.

2. Deep-sea Mining in Indonesia

In recent years, the environmental and legal complications with marine exploitation have come into sharp focus, particularly major incidents that reveal the gaps in existing regulatory frameworks. One of those cases that can be highlighted to analyze the legal things for exploitation in the ocean is Oil Spill in Karawang Coast.³¹ This event happened when Pertamina, a major Indonesian state-owned oil and gas business, had a devastating explosion at one of its facilities in the region, resulting in a huge oil leak into the nearby ocean. After the spillage, people who lived near the Karawang Coast faced devastating effects on the coastal waters for their livelihood, especially the fishermen. The contamination disrupted fishing activities, leading to a sharp decline in catch and income. The oil spill also harmed the sea due to dangerous chemicals contained in the oil, threatening both wildlife and marine health.

In response, Pertamina initially asked local fishermen to assist in the cleanup by collecting the spilt oils which can lead to up to 50–60 sacks of oil and are given to specific authorities.³² From doing this work, the fishermen were compensated approximately 100.000 rupiah for every 10 kilograms of collected oil waste.³³ Other sources stated that the fishermen were rewarded 120.000 rupiahs for each day.³⁴ However, this idea by Pertamina was faced with criticism as it was considered cruel, exploitative, and unsafe. The fishermen, lacking specialized training and equipment, were exposed to additional health risks due to the dangerous nature of the chemicals in the oil. Eventually, Pertamina deployed a professional team to handle the oil spill on the Karawang Coast. They mobilized around 27 ships and 12 oil boom sets devices used to contain and confine the oil that spilt on the ocean's surface.³⁵ The oil boom acted as a barrier in

³¹ Stefano Reinard Sulaiman and Jakarta Post, "Pertamina's Oil Spill Affects 10 Villages, Seven Beaches in Karawang, Bekasi - Business," The Jakarta Post, July 29, 2019, www.thejakartapost.com/news/2019/07/29/pertaminas-oil-spill-affects-10-villages-seven-beaches-in-karawang-bekasi.html, accessed on July 31, 2024.

³² M Ambari, "Begini Nasib Buruk Masyarakat Pesisir akibat Tumpahan Minyak di Karawang," MONGABAY: Situs Berita Lingkungan, July 29, 2019, <https://www.mongabay.co.id/2019/07/29/begini-nasib-buruk-masyarakat-pesisir-akibat-tumpahan-minyak-di-karawang/>, accessed on October 3, 2024.

³³ *Ibid.*

³⁴ CNN Indonesia, "Pertamina Beri 'Ganti Rugi' Nelayan Tak Melaut di Karawang," CNN Indonesia, August 9, 2019, www.cnnindonesia.com/ekonomi/20190808182107-85-419664/pertamina-beri-ganti-rugi-nelayan-tak-melaut-di-karawang, accessed on July 31, 2024.

³⁵ Gustidha Budiartie, "Tumpahan Minyak di Laut Karawang, Ini Langkah pertamina," CNBC Indonesia, July 22, 2019, <https://www.cnbcindonesia.com/news/20190722164136-4-86692/tumpahan-minyak-di-laut-karawang-ini-langkah-pertamina>, accessed on July 31, 2024.

preventing any further contamination and mitigating the environmental impact caused by the spillage.

Over the past several years, Pertamina has strived to align its operations with various regulatory frameworks, including Government Regulation No. 19 the Year 1999, Law No. 32 the Year 2009, President Regulation No. 109 the Year 2006, and President Regulation No. 83 the Year 2018. Despite it all, Pertamina has only fully complied with one regulation which is the President Regulation No. 109 Year 2006.³⁶ From a regulatory perspective, the lack of specific regulations governing deep-sea mining has created challenges such as no boundaries or standards for exploitation and many more. With the lack of clear boundaries and standards for marine exploitation, corporations such as Pertamina often operate in a regulatory gray area. Regulations are crucial fundamentals as standards and benchmarks to help corporations ensure safety and responsible operations. However, in Indonesia and internationally, marine exploration and exploitation remain inadequately regulated. Current marine laws focus mainly on regulating the national borders in maritime zones, protecting each country's sea area, and resource utilization, while mining activities, including deep-sea mining, are still equated with regular mining activities by the Regular Mining Act which does not specifically address the unique problems of deep-sea mining.

3. Environmental Challenges of Deep-sea Mining

Pertamina Oil Spilled in the Karawang Coast case is one of a lot of cases that usually happen in deep-sea mining. Based on the case, from an environmental perspective, Pertamina exploration and exploitation have harmed the ocean ecosystem. While Pertamina did the exploitation for mining oil in the ocean, the machine exploded and spilt a lot of chemical waste into the ocean. Scientists have said that chemical waste that was spilt into the ocean can mix with composition and compounds.³⁷ If the composition and compounds have changed, it will affect the ecosystem and living beings in the ocean. There are several impacts caused by deep seabed mining.

The first impact caused by deep-sea mining is biodiversity loss. Biodiversity loss is a condition of the decline in several genes, species, and individual organisms in a given area.³⁸ In

³⁶ Azka Bintang Amffa Muhammad, Muhammad Fadhil Arsy, and Fuad Mahfud Assidiq, "Analisis Dampak *Oil Spill* Pada Kehidupan Masyarakat Pesisir Karawang dalam Perspektif Hukum dan Lingkungan," *Riset Sains Dan Teknologi Kelautan* 6, no. 1 (May 29, 2023): 86–89.

³⁷ Rahul Sharma, "Environmental Issues of Deep-Sea Mining : Impacts, Consequences and Policy Perspectives" (Cham, Switzerland: Springer, 2019).

³⁸ John P. Rafferty, "Biodiversity Loss | Causes, Effects, & Facts," in *Encyclopædia Britannica*, April 16, 2019, <https://www.britannica.com/science/biodiversity-loss>, accessed on July 30, 2024.

this case, biodiversity loss can happen when the chemical waste pollutes the biodiversity in the ocean. Unusual chemicals will affect the organisms in the ocean quickly or slowly. The chemical waste will result in environmental damage and life disruption, including the death of many ocean organisms.³⁹ It is a start for declining genetic diversity, causing a rapid fall in ocean population. If it continues to happen, this loss can lead to a breakdown in the functioning of the ocean ecosystem and can affect the whole world's ecosystem.

The second impact that might be caused by deep-sea mining activities is habitat destruction by sediment plums. According to research published in the Proceedings of the National Academy of Sciences of the United States of America, plumes produced by mining can obstruct respiratory and olfactory surfaces, which can be hazardous.⁴⁰ This started when the collector vehicles mined the seafloor creating sediments which would be resuspended creating plumes over hundreds of kilometers from the mining sites. These sediments plumes would smother the suspension feeder like cold water corals or sponges.⁴¹ If the coral waters or sponges are smothered, many corals will start to deteriorate which leads to many organisms losing their habitat, disrupting the ecosystem further.

The third impact that should be considered that will affect the environment is pollution and waste management issues. It is undebatable that the chemical waste that is thrown or spoils into the sea will pollute the ocean. However, there are other pollutants caused by mining including noise, light pollutants, and sediment plumes.⁴² These kinds of pollution can hurt sea creatures that are living even in the deep waters. Many sea creatures have different tolerance for receiving sound and light. Underwater sound is essential for mating communication and may even be used for navigation by many deep-sea fish.⁴³ Some sea creatures that live in the deep ocean, are sensitive to receiving sound and light due to them using it for doing daily activities such as catching prey mating. The disturbance from those fumes created by mining vehicles and

³⁹ National Geographic Society, "Marine Pollution," National Geographic, September 18, 2024, <https://education.nationalgeographic.org/resource/marine-pollution/>, accessed on October 3, 2024.

⁴⁰ Jeffrey C. Drazen, *et.al.*, "Midwater Ecosystems Must Be Considered When Evaluating Environmental Risks of Deep-Sea Mining," Proceedings of the National Academy of Sciences 117, no. 30 (July 28, 2020): 17455–60.

⁴¹ Deep Sea Conservation Coalition, "Deep Sea Threats: Mining, Fishing, Geoengineering - DSCC," Deep Sea Conservation Coalition, accessed July 31, 2024, <https://deep-sea-conservation.org/key-threats/#:~:text=On%20the%20abyssal%20plains%2C%20deep>, accessed on July 31, 2024.

⁴² IUCN (International Union for Conservation of Nature), "Deep-Sea Mining," iucn.org, May 2022, <https://iucn.org/resources/issues-brief/deep-sea-mining>, accessed on October 3, 2024.

⁴³ The European Academies' Science Advisory Council (EASAC), "Deep-Sea Mining: Assessing Evidence on Future Needs and Environmental Impacts," interacademies.org, June 2023, www.interacademies.org/publication/deep-sea-mining-assessing-evidence-future-needs-and-environmental-impact, accessed on October 3, 2024

overall activities could hinder the usage of light and sound navigation for sea creatures such as whales and sharks. It can be said that pollution too for those sea creatures.

The incident caused by Pertamina had surely affected the ecosystem, not just the living beings in the deep ocean, but also the people who lived on the coast. The last thing that needs to be given attention to this problem is the health of people, especially those who live near the sea or live on the coast. The health of those people will be affected because of exposure to the radiation of chemical waste or inadvertently consuming those chemicals through seafood for their food. Besides the healthiness of people who live there, their livelihoods will also be disrupted due to fish and other creatures who have died or become contaminated by the chemical waste, making it difficult for them to distribute the seafood.

4. Economic Implications of deep-sea mining

The corporation that had conducted mining activities can not be fully blamed. Deep-sea mining has so much potential due to the ocean not being explored thoroughly. According to the data obtained, the ocean contains a lot of natural resources such as oil, gas, minerals, methane hydrates, etc.⁴⁴ Pertamina has the right to explore and do mining in Indonesia's deep seas. Deep-sea mining will increase not just their profit but also boost the national economy and society. deep-sea mining will increase the revenue generation for businesses, both public and private corporations.⁴⁵ There's a prediction that deep-sea mining is the key to economic benefits due to some factors related to the business such as demands, input-output, flows of goods, etc.⁴⁶

Deep-sea mining will impact economic significance such as job creation and technological advancements. Mining activities will increase job vacancies for people, especially if the mining is in an area that has not been explored thoroughly. Many people will obtain new jobs if this sector can develop and succeed. It will give new opportunities for society, especially for people who live near the coast. Moreover, it will help technology advancements as well since deep-sea mining needs advanced technology due to the high difficulty of its excavation. The technology needs to be customized between the cost, human resources, geography, and others that affect the advancement of the technology.⁴⁷

⁴⁴ United Nations, World Ocean Review: Marine Resources - Opportunities and Risks (Maribus, 2014).

⁴⁵ Federal Ministry for Economic Affairs and Energy of Germany, "Analysis of the Economic Benefits of Developing Commercial deep-sea mining Operations in Regions Where Germany Has Exploration Licences of the International Seabed Authority, as Well as Compilation and Evaluation of Implementation Options with a Focus on the Performance of a Pilot Mining Test," Report No. 301 000 285 - 01, September 30, 2016.

⁴⁶ *Ibid.*

⁴⁷ J.B Donges, "The Economics of Deep-Sea Mining," (Springer Science & Business Media, 2012).

5. Social Welfare Considerations Impacts on Local Communities

Sand mining took place in the Kamelanta Village and had several impacts, both positive and negative. Due to the harsh materials thrown onto the shores, several mangroves were destroyed; the beach was eroded; the quality of the ocean's ecosystem was reduced; and the marine food chain system was disrupted.⁴⁸ However, the citizens who resided in Kamelanta village experienced positive impacts, such as an increase in income diversification and the opportunity to supply construction materials.⁴⁹

Impacts turned differently in other sea mining cases, such as Meranti Island, where the citizens are mainly fishermen. Fishermen on this island rely on the ecosystem for their main income.⁵⁰ If a slight disruption in the marine ecosystem occurs, it will affect the entire fishermen's livelihood. After the sea mining in search for lead occurred, a fisherman stated that their economic income was threatened, due to the fish having trouble breathing and moving to other sea areas. Based on the research conducted by a study in Tanjung Medang Village, the fishermen have made reports on how sea mining activities have caused disruptions in their fishing operations.⁵¹ The fishermen said they previously succeeded in acquiring high-valued fish such as carp and threadfins. However, deep-sea lead mining accelerates the erosion rate from 15 meters per year to now 35 meters per year, threatening both the income and houses of fishermen.

The negative impacts deep-sea mining had on the fishermen's livelihoods and Matras Beach led to two scenarios, the increase in operational fees and the unstable income.⁵² With the appearance of sea mining, the fishermen must purchase more solar due to the fishing area expansion. The fishermen are also forced to lend capital to middlemen. These issues have led to a decrease in income by 42-69% for the fishermen.⁵³ The recommendations that previous researchers in this article could give are dispute resolutions through negotiations, mediation, and arbitration, or socialization through public discussions.

The fishermen will also experience further social Indigenous people displacement, as seen in the deep-sea mining project called "Solwara 1" conducted in Papua New Guinea.⁵⁴ The social

⁴⁸ Surianti Surianti, Asrim Asrim, and Riko Wardana, "Analisis Dampak Penambangan Pasir Laut Terhadap Lingkungan Dan Sosial-Ekonomi Di Desa Kamelanta Kecamatan Kapontori Kabupaten Buton," *Jurnal Media Inovasi Teknik Sipil UNIDAYAN* 12, no. 2 (October 25, 2023): 59-64.

⁴⁹ *Ibid.*

⁵⁰ Tirta Anugerah, Arya Hadi Dharmawan, and Ivanovich Agusta, *loc.cit.*

⁵¹ *Ibid.*

⁵² Edward Arnanda, "Analisis Dampak Aktivitas Pertambangan Timah Laut Terhadap Sosial Ekonomi Masyarakat Nelayan," *Akuatik Jurnal Sumberdaya Perairan* 15, no 2 (February 21, 2022): 89-99.

⁵³ *Ibid.*

⁵⁴ E.I. van Putten et al., "History Matters: Societal Acceptance of Deep-Sea Mining and Incipient Conflicts in Papua New Guinea," *Maritime Studies* 22, no. 32 (July 3, 2023): 1-17.

acceptance of sea mining is divided into three dimensions: civilians, governments, and the market. The company conducting this sea mining, Nautilus, has received backlash due to its mining activities. Reporters and civilians deemed that this falls into overexploitation of the marine environment. The company has also failed to provide adequate government licenses, due to the corrupt government allowing large companies to conduct harmful activities towards the ecosystem in pursuit of financial aims.⁵⁵ Not only that, the community shows a lack of acceptance when external parties are claiming authority over what is deemed as Papua New Guinea's jurisdiction.

D. Concept Development

From the issues that appeared by deep-sea mining, we can conclude that a good mechanism is needed to solve the problem. The first solution is, a good regulation to standardize the mine activities. At this moment, Indonesian regulations still do not specify mine activities, same with international law. The government needs to make a regulation related to deep-sea mining. The elements needed for good regulation must balance a more sustainable approach that prioritizes environmental protection alongside economic development. Now, these 'good regulations' based on the issues mentioned beforehand, must have stringent environmental standards that could abide by the Environmental Impact Assessments (EIAs) before any mining activities could be conducted. This part of the regulations could help with the protection of the sensitive ecosystem. Another element could be regulations that close some parts of the sea towards mining in order to preserve biodiversity. The areas could be seen as restricted and protected areas where endangered species reside and where marine creatures can hunt or reproduce safely. Apart from the marine ecosystem, there must be a strong waste management system to minimize ocean toxication along with sanctions, and implement strong pollution control. To ensure these regulations are followed, regular monitoring and assessment with an international standard can be implemented. These regulations, if conducted properly, will affect the activities of the industry, specifically the implementation of preparation, process, and control. However, if we want to create a safe place to conduct extraction that harmonizes with the ocean's marine life, some conditions must be made to ensure that stability.

⁵⁵ Bainton, N., and M. Macintyre, "Being like a State: How Large Scale Mining Companies Assume Government Roles in Papua New Guinea. In *The Absent Presence of the State in Large-Scale Resource Extraction Projects*," (Canberra: Australian National University Press, 2021).

In line with these recommendations, the International Union for Conservation of Nature (IUCN) has held a congress to suspend mining in the deep sea until several critical issues are settled.⁵⁶ These conditions include a thorough understanding of the risks associated with mining and the implementation of effective protective measures. Resolution 122 also states that there needs to be a transparent environmental impact assessment based on the studies done regarding the deep sea. They also want to apply the Polluter Pays Principle which could be essential in creating policies to incorporate economic principles while extracting minerals. These guidelines can also be used as a basis for creating a regulation that could further protect the environment while integrating economic values.

Then the second option that can be a solution for those issues, is using geo-political and socio-legal views while implementing the regulation. It is related to the condition because in regulation implementation, understanding the conditions is required. The analysis of seabed exploitation needs a geopolitical and socio-legal point of view.⁵⁷ One of the challenges in economics these days is increasing global minerals supply due to high society demand. The seabed exploitation becomes a solution for new sources of reliable and ethically sourced minerals. To actualize this idea, it needs deep-sea research to help identify the necessary measures to make the sources sustainable, whether through geo-political and socio-legal studies that are suitable to analyze seabed exploitation in consideration to protect the environment.⁵⁸

Geopolitics is a framework that is used to understand the complex world geographically. It is usually used to explain the method by which countries, businesses, and even terrorist groups, etc. try to reach their political goals by controlling geographic features. This particular scope is important because it takes a look at particular uses of power and how countries or groups compete to control the entities within the international community to reach their goals. Geopolitics can also affect economic performance if we have a better understanding.

In financial markets, it happens through direct capital controls or financial sanctions indirectly through increased uncertainty; higher risk premia; or asset price surges. On the trade side, the increasing restrictions in some areas can disrupt trade flows and also supply-demand problems. The restrictions can also affect the process that will be higher and lead to shortages of some resources, affecting industrial production. Not only that, but geopolitics is also used for

⁵⁶ IUCN, *Resolution 122*, IUCN World Conservation Congress, Marseille, September 2021.

⁵⁷ Egorov, L. et al., "Sustainable Seabed Mining : Guidelines and a new concept for Atlantis II Deep," The LRET Collegium Series: Seabed Exploitation 4, 2012.

⁵⁸ Michael W. Lodge, "How to Mine the Oceans Sustainably," *Scientific American*, August 11, 2020, <https://www.scientificamerican.com/article/how-to-mine-the-oceans-sustainably/>, accessed on July 31, 2024.

political affairs that will influence economic activity through various fiscal policies, like taxes or spending, and economic strategic decisions.

Furthermore, if seen from a socio-legal perspective, it is a study that is used to analyze, answer, and give solutions to legal issues happening in society with theory and interdisciplinary methodology, specific to social science. Socio-legalization is a crucial aspect of implementing the regulation, which will be a part of the solution mechanism in society. Adrian Bedner, a Law Professor at Leiden University, thought socio-legal is important to understand the law as a doctrine and normative.⁵⁹ Socio-legal will help to create strategies for implementing the regulation.

Combining the perspectives of socio-legal and geopolitical would be a great thing to implement in strategies. These perspectives are needed to know the steps to implement the regulations relevant to conditions in the area. Although the concept of the regulation is great, if there are no comprehensive strategies for the implementation, it is just the same as nothing. It is necessary to make sure how the implementation could work in society. In the end, the government should consider the use of geopolitical and socio-legal mining for deep-sea mining.

The last solution is working together with an organization or local community in the area. The government needs to reach out to the organization or local community for the realization of the idea of the regulation. Continuous public engagement and consultation in making the regulation more transparent and effective. In cases where perhaps there is a clash between environmental protection and the interest of resource exploitation, further steps could be taken such as a dispute resolution system that will include all key actors of the issue—the government, private companies, local communities, etc. These cases can also be further regulated for the acceptance of mediation, negotiation, and arbitration regarding the conflict of interest. These solutions could help in making stricter deep-sea mining regulations that apply for environmental protection and reduce the risks that could erupt from the extraction.

E. Closing

Given Indonesia's immense natural resources, including minerals, oil, and coal, deep-sea mining has tremendous economic growth potential. Indonesia, with its enormous marine area, is well-positioned to focus on this business. However, deep-sea mining has significant

⁵⁹ Universitas Brawijaya, "A Law Professor from Leiden University Gives a Public Lecture on the Sociology of Law at FH UB," *hukum.ub.ac.id*, August 28, 2022, <https://hukum.ub.ac.id/en/profesor-hukum-leiden-university-mengisi-kuliah-umum-tentang-sosiologi-hukum-di-fh-ub/>, accessed on October 3, 2024.

environmental and societal concerns. Chemical waste and other pollutants from mining operations can contaminate the ocean, harming ecosystems, marine life, and residents. The lack of precise national rules exacerbates these challenges, forcing firms to establish their standards. Incidents such as the 2019 oil leak off the Karawang Coast show the critical necessity for strict and particular maritime legislation. Pertamina's management of this disaster demonstrates regulatory weaknesses in addressing the risks and environmental repercussions of mining.

To harness the benefits of deep-sea mining while mitigating its risks, several key improvements are necessary. From the regulative perspective, first, appropriate regulations must be devised to govern deep-sea mining activities appropriately. Second, strategic implementation plans should include geopolitical and socio-legal considerations to guarantee thorough oversight. Third, engagement with various entities—organizations, local populations, and private companies is critical for understanding and addressing the unique situations of mining sites, reducing possible dangers. From the environmental perspective, establishing strict environmental standards that comply with the Environmental Impact Assessments (EIAs) could lessen the harm caused by deep-sea mining. Furthermore, creating designated marine areas and the implementation of robust waste management. Experts like Thayer urge a cautious approach, emphasizing the importance of comprehensive scientific understanding and rigorous controls to enhance national security.⁶⁰ A global embargo on deep-sea mining is frequently proposed until these requirements are satisfied, guaranteeing that the benefits do not come at an unacceptable cost to the environment or human communities. By resolving these gaps and problems, Indonesia may fulfill the economic potential of deep-sea mining while also protecting social welfare and environmental sustainability.

F. Bibliography

Statutory Regulations

United Nations Convention on the Law of the Sea, (Adopted on 30 April 1982, enters into force on November 16, 1994).

Indonesia. *Undang-Undang (UU) Nomor 3 Tahun 2020 Amended by UU Nomor 4 Tahun 2009 tentang Pertambangan Mineral dan Batubara*. Law No. 3 Year 2020, LN Year 2020 No. 147 TLN No. 6525.

⁶⁰ Ferdy Leorocho, et. al., "Comparative Study on Maritime Security Theory of Mahan Alfred Thayer and Geoffrey Till on the Strategic and Practical Implications of Constructing a Sea Defense," *International Journal of Progressive Sciences and Technologies (IJPSAT)* 38, no. 1 (April 1, 2023): 456-464.

- Indonesia. *Undang-Undang (UU) Nomor 32 Tahun 2014 tentang Kelautan*. Law No. 32 the Year 2014, LN Year 2014 No. 294 TLN No. 5603.
- Indonesia, *Undang-Undang (UU) Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup*, Law No. 32 Year 2009, LN Year 2009 No. 140 TLN No. 5059.
- Indonesia, *Undang-Undang (UU) Nomor 4 Tahun 2009 tentang Pertambangan Mineral dan Batubara*, Law No. 4 Year 2009, LN Year 2009 No. 4 , TLN No. 4959.
- Indonesia. *Undang-Undang (UU) Nomor 17 Tahun 1985 tentang Pengesahan United Nations Convention on the Law of the Sea (Konvensi Perserikatan Bangsa-Bangsa tentang Hukum Laut)*, Law No. 17 Year 1985, LN Year 1985 No. 76 TLN No. 3319.
- Indonesia. *Peraturan Pemerintah Nomor 21 Tahun 2021 tentang Penyelenggaraan Penataan Ruang*, Government Regulation No. 21 Year 2021, LN Year 2021 No. 31 TLN No. 6633.
- Indonesia. *Peraturan Pemerintah Nomor 23 Tahun 2010 tentang Pelaksanaan Kegiatan Usaha Pertambangan Mineral dan Batu Bara*. Government Regulation No. 23 Year 2010, LN Year 2010 No. 259 TLN No. 5111.
- Indonesia. *Peraturan Pemerintah Nomor 19 Tahun 1999 tentang Pengendalian Pencemaran dan/atau Perusakan Laut*. Government Regulation No. 19 Year 1999, LN Year 1999 No. 32 TLN No. 3816.
- Indonesia. *Peraturan Presiden Nomor 83 Tahun 2018 tentang Penanganan Sampah Laut*. President Regulation No. 83 of 2018.
- Indonesia. *Peraturan Presiden Nomor 109 Tahun 2006 tentang Penanggulangan Keadaan Darurat Tumpahan Minyak di Laut*. President Regulation No. 109 Year 2006.
- IUCN. *Resolution 122*. IUCN World Conservation Congress. Marseille. September 2021.

Books

- Cuyvers, Luc, Whitney Berry, Gjerde Kristina, Thiele Torsten, and Wilhelm Caroline. *Deep Seabed Mining: A Rising Environmental Challenge*. IUCN, International Union for Conservation of Nature, 2018.
- Donges, J.B. *"The Economics of Deep-Sea Mining."* Springer Science & Business Media, 2012.

Egorov, L. et al., “Sustainable Seabed Mining: Guidelines and a new concept for Atlantis II Deep,” The LRET Collegium Series: Seabed Exploitation 4, 2012.

Sharma, Rahul. “*Environmental Issues of Deep-Sea Mining: Impacts, Consequences, and Policy Perspectives.*” Cham, Switzerland: Springer, 2019.

Willaert, Klaas. “*Regulating deep-sea mining.*” Springer Nature, 2021.

Journal Articles

Anugerah, Tirta, Arya Hadi Dharmawan, and Ivanovich Agusta. “Dampak Penambangan Timah Laut Terhadap Sumber Penghidupan Rumah Tangga Nelayan Di Kabupaten Meranti.” *BHUMI: Jurnal Agraria Dan Pertanahan* 7, no. 1 (June 14, 2021): 112–25. <https://jurnalbhumi.stpn.ac.id/index.php/JB/article/view/480>.

Arnanda, Edward. “Analisis Dampak Aktivitas Pertambangan Timah Laut Terhadap Sosial Ekonomi Masyarakat Nelayan.” *Akuatik Jurnal Sumberdaya Perairan* 15, no 2 (February 21, 2022): 89–99.

Conde, Marta, Aletta Mondré, Kimberley Peters, and Philip Steinberg. “Mining Questions of ‘What’ and ‘Who’: Deepening Discussions of the Seabed for Future Policy and Governance.” *Maritime Studies* 21, no. 3 (July 3, 2022): 327–38. <https://doi.org/10.1007/s40152-022-00273-2>.

Drazen, Jeffrey C., Craig R. Smith, Kristina M. Gjerde, Steven H. D. Haddock, Glenn S. Carter, C. Anela Choy, Malcolm R. Clark, et al. “Midwater Ecosystems Must Be Considered When Evaluating Environmental Risks of Deep-Sea Mining.” *Proceedings of the National Academy of Sciences* 117, no. 30 (July 28, 2020): 17455–60. <https://doi.org/10.1073/pnas.2011914117>.

Leorocho, Ferdy., et. al. “Comparative Study on Maritime Security Theory of Mahan Alfred Thayer and Geoffrey Till on the Strategic and Practical Implications of Constructing a Sea Defense.” *International Journal of Progressive Sciences and Technologies (IJPSAT)* 38, no. 1 (April 1, 2023): 456-464.

Martin, Anne-Sophie. “Spaceports on Coastal Areas and Spaceflights: Legal Considerations on the Protection of Marine Environment.” *Maritime Safety and Security Law Journal*, no. 13 (2023): 1–20.

Muhammad, Azka Bintang Amffa, Muhammad Fadhil Arsy, and Fuad Mahfud Assidiq. “Analisis Dampak Oil Spill Pada Kehidupan Masyarakat Pesisir Karawang dalam

Perspektif Hukum dan Lingkungan.” *Riset Sains Dan Teknologi Kelautan* 6, no. 1 (May 29, 2023): 86–89. <https://doi.org/10.62012/sensistek.v6i1.24261>.

Putten, E.I. van, S Aswani, W.J Boonstra, R. De la Cruz-Modino, J Das, M Glaser, N Heck, et al. “History Matters: Societal Acceptance of Deep-Sea Mining and Incipient Conflicts in Papua New Guinea.” *History Matters: Societal Acceptance of deep-sea mining and Incipient Conflicts in Papua New Guinea* 22, no. 3 (July 3, 2023). <https://doi.org/10.1007/s40152-023-00318-0>.

Surianti, Surianti, Asrim Asrim, and Riko Wardana. “Analisis Dampak Penambangan Pasir Laut Terhadap Lingkungan dan Sosial-Ekonomi di Desa Kamelanta Kecamatan Kapontori Kabupaten Buton.” *Jurnal Media Inovasi Teknik Sipil UNIDAYAN* 12, no. 2 (October 25, 2023): 59–64. <https://doi.org/10.55340/jmi.v12i2.1433>.

Tobias, Evan. “Commencing Deep Seabed Mining: A Review on Law No. 3 of 2020 on Mineral and Coal Mining.” *Brawijaya Law Journal* 9, no. 1 (April 30, 2022): 59–75. <https://doi.org/10.21776/ub.blj.2022.009.01.05>.

Universitas Brawijaya. “A Law Professor from Leiden University Gives a Public Lecture on the Sociology of Law at FH UB.” *hukum.ub.ac.id*. August 28, 2022, <https://hukum.ub.ac.id/en/profesor-hukum-leiden-university-mengisi-kuliah-umu-m-tentang-sosiologi-hukum-di-fh-ub/>. Accessed on October 3, 2024.

Wang, Chuanliang, Qian Zhao, and Yen-Chiang Chang. “On the Legal Status of Marine Fishery Resources: From the Perspectives of International Fishery Law.” *Heliyon* 9, no. 4 (April 1, 2023): e15354–54. <https://doi.org/10.1016/j.heliyon.2023.e15354>.

World Economic Forum. “Decision-Making on Deep-Sea Mineral Stewardship: A Supply Chain Perspective.” World Economic Forum, April 12, 2022. <https://www.weforum.org/publications/decision-making-on-deep-sea-mineral-stewardship-a-supply-chain-perspective/>.

Organization

Ministry of Energy and Mineral Resources Republic of Indonesia Geological Agency. *Indonesian Minerals, Coal, And Geothermal Resources And Reserves 2021*. Indonesia: Ministry of Energy and Mineral Resources Republic of Indonesia Geological Agency, 2021.

Article of newspaper or magazine, internet, or others.

Advisory Committee on The Protection of The Sea. “Deep Seabed Mining (WG7) – Advisory Committee on the Protection of the Sea.” [acops.org.uk. https://www.acops.org.uk/deep-seabed-mining-wg7/](https://www.acops.org.uk/deep-seabed-mining-wg7/). Accessed on July 20, 2024.

Ambari, M. “Begini Nasib Buruk Masyarakat Pesisir akibat Tumpahan Minyak di Karawang.” MONGABAY: Situs Berita Lingkungan, July 29, 2019. <https://www.mongabay.co.id/2019/07/29/begini-nasib-buruk-masyarakat-pesisir-akibat-tumpahan-minyak-di-karawang/>. Accessed on July 31, 2024.

Ashford, Oliver, Jonathan Baines, Melissa Barbanell, and Ke Wang. “What We Know about Deep-Sea Mining—and What We Don’t.” World Resources Institute, July 19, 2023. <https://www.wri.org/insights/deep-sea-mining-explained>. Accessed on July 19, 2024.

Budiartie, Gustidha. “Tumpahan Minyak di Laut Karawang, Ini Langkah Pertamina.” CNBC Indonesia, July 22, 2019. <https://www.cnbcindonesia.com/news/20190722164136-4-86692/tumpahan-minyak-di-laut-karawang-ini-langkah-pertamina>. Accessed on July 31, 2024.

CNN Indonesia. “Pertamina Beri 'Ganti Rugi' Nelayan Tak Melaut di Karawang,” CNN Indonesia, August 9, 2019, <https://www.cnnindonesia.com/ekonomi/20190808182107-85-419664/pertamina-beri-ganti-rugi-nelayan-tak-melaut-di-karawang>. Accessed on July 31, 2024.

Deep Sea Conservation Coalition. “Deep Sea Threats: Mining, Fishing, Geoengineering - DSCC.” Deep Sea Conservation Coalition. Accessed July 31, 2024. <https://deep-sea-conservation.org/key-threats/#:~:text=On%20the%20abyssal%20plains%2C%20deep>. Accessed on July 31, 2024.

European Academies' Science Advisory Council. “Deep-Sea Mining: Assessing Evidence on Future Needs and Environmental Impacts Contents,” June 8, 2023.

Federal Ministry for Economic Affairs and Energy of Germany. “Analysis of the Economic Benefits of Developing Commercial Deep-sea Mining Operations in Regions Where Germany Has Exploration Licences of the International Seabed Authority, as well as Compilation and Evaluation of Implementation Options with a Focus on the Performance of a Pilot Mining Test.” Report No. 301 000 285 - 01, September 30, 2016. Accessed on July 31, 2024.

Jakarta Post, Fadli. "Oil Spills Hit Batam Coast - Archipelago." The Jakarta Post, May 4, 2023.

<https://www.thejakartapost.com/indonesia/2023/05/04/oil-spills-hit-batam-coast.html>. Accessed on July 31, 2024.

Jamasmie, Cecilia. "Canadian Deep-Sea Miner TMC to Seek Licence in 2024." *mining.com*, August 3, 2023.

<https://www.mining.com/canadian-deep-sea-miner-tmc-to-seek-licence-in-2024/>. Accessed on July 19, 2024.

Lodge, Michael W. "How to Mine the Oceans Sustainably." *Scientific American*, August 11, 2020.

<https://www.scientificamerican.com/article/how-to-mine-the-oceans-sustainably/>. Accessed on July 31, 2024.

Logan, Michelle. "Deep Seabed Mining." The Ocean Foundation, August 7, 2010.

<https://oceanfdn.org/deep-seabed-mining/>. Accessed on July 20, 2024.

National Geographic Society. "Marine Pollution." National Geographic. September 18, 2024.

<https://education.nationalgeographic.org/resource/marine-pollution/>. Accessed on October 3, 2024.

Rafferty, John P. "Biodiversity Loss | Causes, Effects, & Facts." In *Encyclopædia Britannica*, April 16, 2019.

<https://www.britannica.com/science/biodiversity-loss>. Accessed on 30 July, 2024.

Rowlatt, Justin. "Greenpeace Could Be Thrown out of UN Deep-Sea Mining Body." *Www.bbc.com*, March 18, 2024.

<https://www.bbc.com/news/science-environment-68576735>. Accessed on July 20, 2024.

Runwal, Priyanka. "The Deep-Sea Mining Dilemma." *Chemical & Engineering News*, October 9, 2023.

<https://cen.acs.org/environment/water/deep-sea-mining-dilemma/101/i33>. Accessed on July 20, 2024.

Stallard, Esme. "Deep-Sea Mining: Norway Approves Controversial Practice." *Www.bbc.com*, January 9, 2024.

<https://www.bbc.com/news/science-environment-67893808>. Accessed on July 19, 2024.

Sulaiman, Stefano Reinard, and Jakarta Post. "Pertamina's Oil Spill Affects 10 Villages, Seven Beaches in Karawang, Bekasi - Business." The Jakarta Post, July 29, 2019. <https://www.thejakartapost.com/news/2019/07/29/pertaminas-oil-spill-affects-10-villages-seven-beaches-in-karawang-bekasi.html>. Accessed on July 31, 2024.

The European Academies' Science Advisory Council (EASAC), "Deep-Sea Mining: Assessing Evidence on Future Needs and Environmental Impacts," [interacademies.org](https://www.interacademies.org), June 2023, <https://www.interacademies.org/publication/deep-sea-mining-assessing-evidence-future-needs-and-environmental-impacts>. Accessed on October 3, 2024.