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**TOPIC:** ***Deep Seabed Mining: Pursuit of the Energy Transition at the expense of the Marine Environment?***

## 1. Introduction.

The resource potential of the deep seabed was first discovered during one of the greatest oceanographic voyages which took place in 1872 to 1876, the HMS Challenger expedition. The trip around the globe saw the discovery of manganese nodules on the ocean floor of the Indian, Atlantic and Pacific Oceans.[1] This paved the way for research into the resources found in the Area. Although the resources of the Area are yet to be economically exploited, exploration is ongoing. The Area has been found to contain resources that are instrumental in developing technologies and infrastructure that is critical to the global initiatives towards combatting climate change.[2] Despite this, there are concerns that the projected mining activities will be destructive to the marine environment.

The discovery of critical metals in the seabed has naturally led to the growing interest in finding how they can be extracted and utilized to supplement what is on land. Mining of terrestrial resources has been ongoing for years and these resources are not inexhaustible even with measures such as recycling. One of the solutions in countering this mineral depletion is extracting the minerals in the seabed.[3] In comparison to the terrestrial reserves, the CCZ alone is said to contain 3.4 to 5 times more Cobalt and 1.2 times more Manganese for example.[4] With the knowledge of such vast resources in the Area, it is unlikely that they shall remain unexploited whilst the land-based reserves get depleted. These minerals have vast uses, but they have also been found to be critical in the development of clean energy technologies and infrastructure.

This paper analyses the hypothesised position that deep seabed mining could be harmful to the seabed and the marine environment. It further analyses whether mining in the Area will have a significant direct contribution to the energy transition given this is one of the primary reasons for the push to extract these resources. The paper discusses the environmental concerns attached to mining in the Area *vis a vis* the critical global agenda that is the energy transition and attempts to find a balance.

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[1] Sir John Murray and Alphonse François Renard, *Report on Deep-Sea Deposits Based on the Specimens Collected During the Voyage of H.M.S. Challenger in the Years 1872 to 1876* (HM Stationery Office 1891).Page 341

[2] Norman Toro, Pedro Robles and Ricardo I Jeldres, 'Seabed Mineral Resources, an Alternative for the Future of Renewable Energy: A Critical Review' (2020) 126 Ore geology reviews 103699. Page 7

[3] T Prior and others, 'Resource Depletion, Peak Minerals and the Implications for Sustainable Resource Management' (2012) 22 Global Environmental Change 577. Page 578

[4] Lisa A Levin, Diva J Amon and Hannah Lily, 'Challenges to the Sustainability of Deep-Seabed Mining' (2020) 3 Nature Sustainability 784.

## 2. What is Deep Seabed Mining

Deep seabed mining refers to the extraction of mineral resources from the ocean floor and subsoil in the Area beyond states' jurisdictional limits. The resources found in the Area include polymetallic nodules, ferromanganese crusts and polymetallic sulphides.[5]All these ores have been found to contain high concentrations of various crucial metals hence the quest for deep seabed mining. For instance, polymetallic nodules have been studied to contain among other metals, Manganese, Nickel, Copper and Cobalt.[6] These nodules have been studied to be found in water depths of about 3000 to 6000 metres and are particularly abundant in the Clarion-Clipperton Zone (CCZ), the Central Indian Ocean Basin and the Peru Basin.[7] Polymetallic nodules sit superficially on the seafloor and their extraction does not require any complex drilling processes.

Ferromanganese Crusts contain among other metals, Cobalt, Manganese, Nickel, Platinum, and rare earth metals. These crusts have been studied to occur in water depths of 400 to 5000 metres and are common in areas that experience volcanic activity.[8] The thick and mineral rich crusts have been found to occur in shallower depths of 800 to 2500 metres and they are most common in the Central and Western Pacific Ocean.[9] Polymetallic sulphides are formed in hydrothermal vents and volcanic chains.[10] They are rich in among other minerals, Iron, Silver, Gold, Copper, Zinc and Lead.

## 3. Deep Seabed Mining and the Energy Transition

The vast negative effects of climate change have caused the entire world to seriously put in place measures to reduce Green House Gas (GHG) emissions and engage in climate change mitigation. To consolidate and strengthen this global response against climate change, the Paris Agreement on Climate Change was adopted in December 2015 and it now has 190 state

[5] Andrea Koschinsky and others, 'Deep-Sea Mining: Interdisciplinary Research on Potential Environmental, Legal, Economic, and Societal Implications' (2018) 9999 Integrated Environmental Assessment and Management. Page 1
[6] ibid. Page 2
[7] ibid.
[8] 'Minerals: Cobalt-Rich Ferromanganese Crusts | International Seabed Authority' < https://www.isa.org.jm/exploration-contracts/cobalt-rich-ferromanganese > accessed 28 January 2021
[9] JR Hein and A Koschinsky, '13.11 - Deep-Ocean Ferromanganese Crusts and Nodules' in Heinrich D Holland and Karl K Turekian (eds), *Treatise on Geochemistry (Second Edition)* (Elsevier 2014) Page 275 <http://www.sciencedirect.com/science/article/pii/B9780080959757011116> accessed 28 January 2021.
[10] Koschinsky and others (n 3). Page 3

parties.[11] The primary objective of the Paris Agreement is to hold the increase in the global average temperatures to below 2℃ above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5℃ above pre-industrial levels.[12] The effects of climate change are not only threatening to land but to the marine environment as well as it causes ocean acidification and warming. The measures towards combating climate change are characterized by reducing reliance on fossil fuels with the end goal of reducing the carbon emissions. In the alternative, it is encouraged to use renewable fuels such as solar, hydro and wind in what is termed as the energy transition to a low carbon economy.[13]

The energy transition is significantly reliant on minerals as they are the core raw materials for the manufacture of clean energy infrastructure.[14] Low carbon energy systems have been found to be more metal intensive than the fossil fuel infrastructures.[15] The construction of wind turbines requires among other metals, Copper, Iron, Manganese, Nickel and Steel.[16] Whether geared or direct drive, all wind turbines require some or all of these metals to be complete. Some of the metals required to manufacture solar photovoltaic systems include Tellurium, Aluminium, Copper, Iron and Lead. Some of these metals are also found in the Area. Other metals found in the Area such as Cobalt, Nickel and Manganese are also critical for energy storage batteries. Notably, copper is a multi-purpose metal that finds a purpose in the manufacture of most renewable energy technologies and almost all electricity generating equipment.[17]

The energy transition seeks to revolutionize the transport sector as well. Today, emissions from cars alone account for 15% of the global GHG emissions.[18] From the exploration so far done, it is estimated that extracting half of the Manganese, Cobalt and Copper in the CCZ will be

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[11] 'Paris Agreement - Status of Ratification | UNFCCC' <https://unfccc.int/process/the-paris-agreement/status-of-ratification> accessed 29 January 2021.
[12] Paris Agreement to the United Nations Framework Convention on Climate Change(adopted 12 December 2015) < https://unfccc.int/sites/default/files/english_paris_agreement.pdf > accessed 29January 2021
[13] Dragana Barjaktarevic and Liljana Markovic, 'The Future of Development of Renewable Sources as a Substitute for Fossil Fuels' (2019) 9 No. 26 International Journal of Economics and Law 19. Page 28
[14] Saleem H Ali and others, 'Mineral Supply for Sustainable Development Requires Resource Governance' (2017) 543 Nature 367.Page 367
[15] World Bank Group, *The Growing Role of Minerals and Metals for a Low Carbon Future* (World Bank, Washington, DC 2017) < http://documents1.worldbank.org/curated/en/207371500386458722/pdf/117581-WP-P159838-PUBLIC-ClimateSmartMiningJuly.pdf > accessed 30 January 2021
[16] ibid. Page 8
[17] Volker Zepf and others, *Materials Critical to the Energy Industry: An Introduction* (2nd Edition, 2014).Page 30
[18] Daina Paulikas and others, 'Where Should Metals for the Green Transition Come from? Comparing Environmental, Social and Economic Impacts of Supplying Base Metals from Land Ores and Seafloor Polymetallic Nodules' (April 2020).

sufficient to electrify one billion cars.[19] As the whole world strives towards a low carbon future and as the land-based mineral reserves get more stretched, it becomes more apparent that seabed minerals are needed to meet society's needs and goals. Deep seabed mining has a critical role to play in the energy transition because the world will not ignore the resources in the Area when in fact, such resources can make a significant contribution to the wellbeing of the planet.

## 4. Effects of Deep Seabed Mining on the Area and the Marine Environment

In addition to supplementing the terrestrial mineral supply, deep seabed mining is good for the terrestrial environment because it does not cause deforestation, displacement of populations like land-based mining activities.[20] The alternative of deep seabed mining spares the terrestrial environment from disruption which is further complicated by existence of human populations. The seabed is still yet to be fully studied and understood; it remains the subject of a lot of scientific research which unfortunately, has been slow. This is exacerbated by the high costs of conducting research in the Area making it a possible venture for the few entities that can afford it. Despite this, there are sufficient preliminary studies to show that deep seabed mining is likely to have adverse environmental effects on both the Area and the marine environment. This has posed a great concern to scientists and conservationists especially since the research on the Area is still at nascent stages. Mining in the Area has further been a cause for great environmental concern since once exploitation starts, a single mining expedition will be a long-term affair and the ramifications are yet to be well understood. The effect of new activities on the poorly understood seabed can be difficult to predict and therefore worrying.[21]

Destabilization of the seafloor is one of the greatest environmental concerns as it will affect its physical and geochemical constitution.[22] This disturbance is set to destabilize the ecological balance of the seafloor that will ultimately, affect the biodiversity. Collection of manganese nodules from the seabed is likely to disturb the sessile species and cause destruction of these species because of both the disturbance caused by the extraction and the use of nodule collectors which can crush some of them.[23] The extraction is expected to cause suspension and movement of plume sediments; the movement of these particles for long distances may cause

[19] Levin, Amon and Lily (n 19). Page 784
[20] James R Hein, Andrea Koschinsky and Thomas Kuhn, 'Deep-Ocean Polymetallic Nodules as a Resource for Critical Materials' (2020) 1 Nature Reviews Earth & Environment 158. Page 163
[21] Jan Magne Markussen, *Deep Seabed Mining and the Environment: Consequences, Perceptions, and Regulations*.( Oxford University Press 1994) Page 34
[22] Luc Cuyvers and others, *Deep Seabed Mining: A Rising Environmental Challenge* (IUCN and Gallifrey Foundation 2018).
[23] Koschinsky and others (n 3).Page 6

contamination and therefore affect the feeding of some organisms and the cleanliness of the water.[24] Deepsea ecosystems have been studied to have very long recovery rates and the negative effects of these mining activities can cause long term destruction.[25]

Once the ores have been extracted, they have to be dried and stored in the ship in readiness for transportation on shore in a process known as de-watering. Once this water is removed from the ore, it is poured back to the ocean. According to studies, this water may contain toxicity particularly from sulphide mining and may have different properties such as PH and temperature when poured back into the sea.[26] When this water is reintroduced to the ocean, it potentially introduces the new properties and toxins to the water which could adversely affect the biodiversity.

Noise and vibrations from the mining ships are other causes of disturbance to the biodiversity. These could cause discomfort to some organisms and even affect their auditory senses due to the persistent unnatural sounds.[27] These mining activities will also require light and the mining vessels are likely to have light. Artificial light is likely to disrupt the normal activities of the organisms at sea as it will also be unnatural for them. Mining is expected to be done by heavy mining ships. If these ships will be fuelled by the fossil fuels, they run the risk to significantly contributing to pollution and contributing to the GHG emissions that the whole world is trying to reduce.[28]

## 5. <u>How to Strike the Balance.</u>

It is evident that the minerals in the Area could be instrumental in facilitating among other causes, the energy transition. At the same time, the Area remains susceptible to damage as a result of these activities and some consequences remain unknown. The best balance can only be achieved if mining activities in the Area proceed but the environmental concerns be mitigated. Article 145 of UNCLOS provides that necessary measures shall be undertaken to protect the marine environment from harm that may arise as a result of activities in the Area. This is further amplified by the 1994 agreement which provides that the ISA shall adopt rules for the protection of the marine environment and make use of scientific research for further

[24] Holly J Niner and others, 'Deep-Sea Mining With No Net Loss of Biodiversity—An Impossible Aim' (2018) 5 Frontiers in Marine Science.< https://www.frontiersin.org/articles/10.3389/fmars.2018.00053/full > accessed 1 February 2021 Page 8
[25] ibid.
[26] Rahul Sharma, *Environmental Issues of Deep Sea-Mining; Impacts, Consequences and Policy Perspectives* (Springer International Publishing 2019).
[27] ibid. Page 55
[28] Hein, Koschinsky and Kuhn (n 28). Page 166

protection of this environment. Implementation of these provisions shall go a long way in attaining a balance between extraction of the minerals and protecting the marine environment.

As envisaged by Article 153 of UNCLOS and the progress so far made by the ISA, mining activities in the Area shall be undertaken and public participation is a crucial element in this progress. This will allow scientists and all relevant stakeholders to give their input on how best to conduct activities in the Area without destabilizing the environment. The ISA has conducted vast stakeholder engagement in which environmental concerns have been voiced and they continue to be incorporated going forward. The draft exploitation regulations contain rules for the sustainable exploitation of the Area's resources whilst having due regard to protection of its environment. This differs from the exploration licensing regime in which the ISA has been granting licences to applicants without any stakeholder engagement. This has caused great concern to scholars and scientists who hold the view that these exploration activities may have impacts on the marine environment and the exploration licencing criterion and process should be made public.[29]

The concern for the marine environment is exhibited in Part IV of the draft exploitation regulations which is on protection of the marine environment.[30]This part requires that contractors and sponsoring states plan, implement, and modify their activities as necessary for the protection of the marine environment. Under draft regulation 47, an applicant for an exploitation license is required to prepare and submit to the ISA an Environmental Impact Statement (EIS). The EIS identifies and predicts the nature and extent of possible environmental impacts of the mining activities. The Applicant is further required to submit an Environmental Management and Monitoring Plan (EMMP) which shall state how the environmental risks identified in the EIS shall be mitigated.[31] From a practical perspective, submission of these reports is a great yet challenging expectation noting that the Area still has a great knowledge gap. There is further no benchmark against which the ISA can measure these reports and grant a licence from a point of confidence and solid information.

One of the ways to mitigate the environmental impacts on the seabed is into invest in safe mining technologies. These are the activities that will have the less effect on the biodiversity in the Area as well as its structural composition. This is also in line with developing green

[29] Jeff A Ardron, Henry A Ruhl and Daniel OB Jones, 'Incorporating Transparency into the Governance of Deep-Seabed Mining in the Area beyond National Jurisdiction' (2018) 89 Marine Policy 58. Page 63
[30] Draft regulations on exploitation of mineral resources in the Area| International Seabed Authority < https://isa.org.jm/files/files/documents/isba_25_c_wp1-e_0.pdf > accessed 1 February 2021
[31] Ibid. Regulation 48

technologies for exploration and exploitation that can be employed for the sustainable use of the Area's resources.[32] As outlined by the UNCLOS and the 1994 Agreement, all efforts should be channelled to scientific research. Response measures can best be undertaken when the subject matter is well understood and there are not too many knowledge gaps.[33]The ISA is further expected to continue with long term monitoring programmes in order to put in place proper response mechanisms for the protection of the Area.[34]

## 6. Conclusion.

Commercial exploitation of minerals in the seabed will significantly increase the supply of metals on land which metals are critical to the energy transition among many other uses. Climate change continues to be a pertinent issue for the entire globe and all countries are making efforts towards its mitigation. Even with alternatives such as recycling, land-based mineral reserves will not be sufficient to meet the world's growing demand for metals. Whilst the seabed provides a solution to supplement these metals, extreme caution needs to be undertaken so as not to cause long term or irreversible harm to the Area and its biodiversity.

From the foregoing, it is evident that once exploitation begins, it is inevitable that the physical structure of the seafloor will be affected and ultimately the biodiversity, some of which will be lost. Whilst there is dire need for these minerals on land, it is important to invest in rigorous scientific research and development of safe mining technologies so as to minimize these consequences. Starting exploitation activities now will mean a lot will be learnt on the job and some consequences could be regrettable as one part of our ecosystem will be given an advantage at the expense of the other when all are in fact, important. Exploitation of the Area should proceed with sufficient knowledge and in a manner that is safe both for land and sea so these resources could continue to serve many other generations to come. Article 153 of UNCLOS permits exploitation of resources of the Area; these resources belong to mankind after all, but this should be balanced against Article 145 on preservation of the marine environment. Efforts towards combating climate change are already ongoing with the available terrestrial resources, it shall not be too late to supplement these efforts with resources from the Area because the demand is still growing. Although exploitation is set to begin in a few years,

[32] Hein, Koschinsky and Kuhn (n 28). Page 167
[33] Lisa A Levin and others, 'Defining "Serious Harm" to the Marine Environment in the Context of Deep-Seabed Mining' (2016) 74 Marine Policy 245. Page 256
[34] RE Boschen and others, 'Mining of Deep-Sea Seafloor Massive Sulfides: A Review of the Deposits, Their Benthic Communities, Impacts from Mining, Regulatory Frameworks and Management Strategies' (2013) 84 Ocean & Coastal Management 54. Page 64

priority should be given to scientific research and developing safe mining technologies to seal the knowledge gaps to a point where it will be deemed to be satisfactorily safe to proceed with extraction.