Position Statement
Deep seabed mining

July 2023

Our asks in brief

From a scientific perspective, there are strong grounds for a moratorium on commercial exploitation of minerals from deep seabed mining while countries and the scientific community deepens the evidence base on a range of potential impacts. We recommend the decision-making process about deep seabed mining is underpinned by robust evidence on its impacts on the marine and adjacent environments, from a breadth of scientific disciplines, sectors and stakeholders. Existing evidence must be considered and evidence gaps addressed before taking potentially irreversible decisions with long-term impacts. Specifically, we suggest:

- More research is needed to address the range of evidence gaps that currently exist, including understanding environmental baselines and the immediate, short and long-term impacts of deep sea mining activities on ocean systems and climate regulation. It is vital to reach a consensus about impacts before making decisions.
- Understanding the impacts of deep seabed mining will require investment in interdisciplinary research and presents an opportunity for the UK to show scientific leadership in this area. Interdisciplinary and international collaboration and knowledge sharing should be encouraged because oceanographic research is complex and expensive and the areas of the seabed that are currently considered for deep seabed mining lie beyond national jurisdiction.
- The evaluation of relative impacts of deep seabed mining and terrestrial mining should be carried out using a breadth of environmental and social factors, including greenhouse gas emissions, pollution impacts, biodiversity loss, and the degradation or loss of ecosystem services, and also consider the timescale and spatial extent of any impacts. This will allow more robust decision making about the most appropriate approach to primary extraction.

Introducing the policies that enable a circular economy for critical minerals should be a significant part of the UK's strategic approach to securing their supplies as it will help to reduce the need for primary extraction, and consequently negative environmental and social impacts, diversify supply chains, and cut waste. The transition to a circular economy will require coherent, harmonised long-term policies, alongside those that reduce the social and environmental impacts of primary extraction. We recommend government should:

- Build and invest in recycling infrastructure that enables the recovery of critical minerals (e.g. lithium, cobalt and rare earth elements (REEs)) to be used as secondary resources and helps prevent the leakage of critical minerals from the economy.
- Incentivise resource-efficient design and production alongside assessments of criticality and substitutability of materials e.g. the role of alternative battery chemistries or new solvents.
- Invest in processes that increase efficiency and reduce the environmental impacts of primary extraction, underpinned by life cycle assessment of products and services from 'cradle to cradle' to ensure informed decisions are made.
- Embed clear and coherent environmental, social and governance (ESG) requirements at all points in the supply chain of products and services.

Context

Minerals such as lithium, indium and rare earth elements (REEs) like dysprosium and neodymium are vital for technologies that will help cut greenhouse emissions and decarbonise our economies. Many of these minerals are classed as 'critical' because of their supply risk and economic importance[1]. The move to a low-carbon energy system requires a significant increase in mineral resources - in both absolute quantities of material and the relative proportion required by low-carbon development[2].

Deep seabed mining (DSM) is proposed as a method for meeting the increased demands for some of the minerals needed for the energy transition, although it is not clear whether it is necessary to use DSM do so. Some forecasts suggest that demand for critical minerals can be met from terrestrial sources[3]. Increased recovery and recycling of critical minerals from end of life products, and resource efficiency, as part of a circular economy will also help to reduce the need for primary extraction. In addition, many of the minerals that can be obtained from DSM are not currently classed as critical[3].

Although the impact of DSM is likely to be significant[4,5], it is not well-understood at present, neither in terms of its timescale nor in terms of its extent, due to this uncertainty, some experts propose a cautious and comprehensive approach to decision making[4,5,6, 7]. While a lot of progress has been made towards understanding the chemical environment in the deep ocean, multiple knowledge gaps exist at the moment regarding the impacts of deep seabed mining on the seafloor. These include gaps in knowledge around the impact on biogeochemistry, ocean carbon sequestration and climate regulation, nutrient cycles, biodiversity, ecosystem services, and understanding the environmental baseline and ways to mitigate any impacts. The impacts on adjacent environments and systems (e.g. climate, geographic, societal) should also be considered since impacts would likely be felt beyond the deep sea. Some deep seabed mining processes may have different impacts than others, and further evidence needs to be gathered about potential differences in impact. There are indications that impacts from DSM likely occur over long timescales and large areas of the seabed. Further research is required to address gaps in our understanding.

It is not clear what the relative impacts of DSM are compared to terrestrial mining and which metrics should be used to compare the impacts. A comprehensive comparison should go beyond a single impact metric such as greenhouse gas (GHG) emissions to encompass a wider range of environmental factors e.g. water pollution, biodiversity loss and societal impacts. Terrestrial mining also has a range of environmental and societal impacts which have to be taken into account. The extraction and processing of natural resources (i.e. materials, fuels, and food) accounts for at least 50% of GHG emissions[8] and has significant impact on ecosystems and communities[9,10]. More energy will be required to extract minerals from lower grade ores due to declining resource quality, leading to increased GHG emissions and waste volumes[9]. Extraction processes for some minerals (e.g. lithium) are particularly water-intensive and so are vulnerable to water stress, making the processes potentially exposed to climate risks. In addition, the extraction and processing of minerals can lead to long-term pollution of water sources[11,12]. However, the environmental impacts of terrestrial mining are likely to be more contained in terms of time and extent compared to DSM. It is important to address these gaps in understanding so that decisions can be made drawing on the evidence of relative impacts across a broad range of social and environmental factors.

Our recommendations

Given the current uncertainties, **we recommend the decision-making process about deep seabed mining is underpinned by robust evidence from a breadth of scientific disciplines, sectors and stakeholders**. Sufficient time should be given to evaluate the existing evidence, and address evidence gaps. Understanding the impacts of deep seabed mining may require investment in interdisciplinary research and presents an opportunity for the UK to show scientific leadership in this area. Science can, and should, inform international approaches to global challenges, and the chemical sciences have an important role to play in doing this, as part of an interdisciplinary approach alongside other disciplines such as the biological sciences, earth and environmental and earth science and engineering.

While critical minerals are essential to the low-carbon energy transition and to many other sectors of the economy (including healthcare, security and consumer electronics), **it is vital that the environmental and social risks of increased mineral demand are managed carefully while also safeguarding supply chains**. It is therefore important to move away from only considering primary extraction on its own to considering the whole materials economy, including resource efficiency and recycling. **This will require long-term, coherent policies and coordination and alliances with global partners.**

Moving from a linear take-make-waste economy to a circular economy for critical minerals will reduce reliance on potentially uncertain sources of critical minerals. These approaches also help to cut waste and reduce embodied energy of second-life products while also reducing the energy requirements and environmental impacts associated with mining and refining of primary materials, by orders of magnitude in many cases[8]. **Enabling policies will be required, including building and investing in UK waste collection and recycling infrastructure to enable the recovery of critical minerals from secondary sources**.

The environmental and social impacts of primary extraction should be addressed with **clear and coherent environmental, social and governance (ESG) requirements at all points in the supply chain.** The chemical sciences (including environmental chemists and chemical oceanographers) can contribute to better and more coherent environmental monitoring as part of ESG. **Investment in more efficient and less environmentally degrading extraction and processing** – including novel hydrometallurgical approaches to extraction and refinement of materials from primary and secondary sources – is required, **underpinned by analysis of the whole lifecycle of products and services from 'cradle to cradle' to ensure informed decisions are made**[13]. The chemical sciences brings important contributions to reducing the environmental impacts of extraction and processing of primary and secondary resources, and to environmental monitoring and the analysis the lifecycle of products and services.

Incentivising resource efficiency[14] in design and production of products is **key to reducing overall resource demand. Product design** that enables efficient and simple deconstruction, reuse and recovery is also important for achieving a circular economy, and **may need to be incentivised via regulation**. **Material choice and substitution decisions** based on assessment of criticality in terms of resource availability, lifecycle and social impact as well as product performance **should also be incentivised**. This will require **investment in research into the substitution of critical minerals**. The chemistry research community is already active in these areas, and partnerships exist between industry and academia. However, further coordination and collaboration should be actively supported by government.

Contact

The Royal Society of Chemistry would be happy to discuss any of the issues raised in this position statement in more detail. Any questions should be directed to policy@rsc.org.

About us

With about 50,000 members in over 100 countries and a knowledge business that spans the globe, the Royal Society of Chemistry is the UK's professional body for chemical scientists, supporting and representing our members and bringing together chemical scientists from all over the world. Our members include those working in large multinational companies and small to medium enterprises, researchers and students in universities, teachers and regulators.

There are numerous ways in which chemical scientists are working towards a sustainable, clean and healthy planet, and this position statement is part of The Royal Society of Chemistry's contribution to do so. We developed this statement drawing on evidence from chemical scientists and other experts working on these issues, and we are grateful to all the individuals who provided their expert input into its development and scientific review.

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[1] Resilience for the Future: The UK's critical minerals strategy. UK Department for Business, Energy and Industrial Strategy, 2022.

[2] The Role of Critical Minerals in Clean Energy Transitions. International Energy Agency, 2021.

[3] Deep-Sea Mining: assessing evidence on future needs and environmental impacts. European Academies Science Advisory Council, 2023.

[4] Deep-sea mining evidence review. British Geological Survey, 2022.

[5] Decision-making on Deep-Sea Mineral Stewardship: A Supply Chain Perspective. World Economic Forum, 2022.

[6] Harmful marine extractives: Deep-Sea Mining. United Nations Environment Programme, 2022.

[7] UNCLOS: The law of the sea in the 21st century. UK House of Lords International Relations and Defence Committee, 2022.

[8] Global Resources Outlook 2019: natural resources for the future we want. UN Environment Programme, 2019.

[9] The Role of Critical Minerals in Clean Energy Transitions. International Energy Agency, 2021.

[10] Critical raw materials in waste electrical and electronic equipment. Institute of Materials, Minerals and Mining, 2020.

[11] Metal mine water pollution. Natural Resources Wales, 2021.

[12] River Wear catchment metal mine water pollution investigations. UK Coal Authority, 2023.

[13] Life Cycle Assessment. Royal Society of Chemistry, 2022.

[14] Resource efficiency involves 'adding greater value to resources, maintaining that value by keeping resources in use for longer, and reducing the environmental impacts associated with the whole life cycle of resources, from their extraction to their disposal'. Resource Efficiency: Potential and Economic Implications. International Resources Panel, 2017.