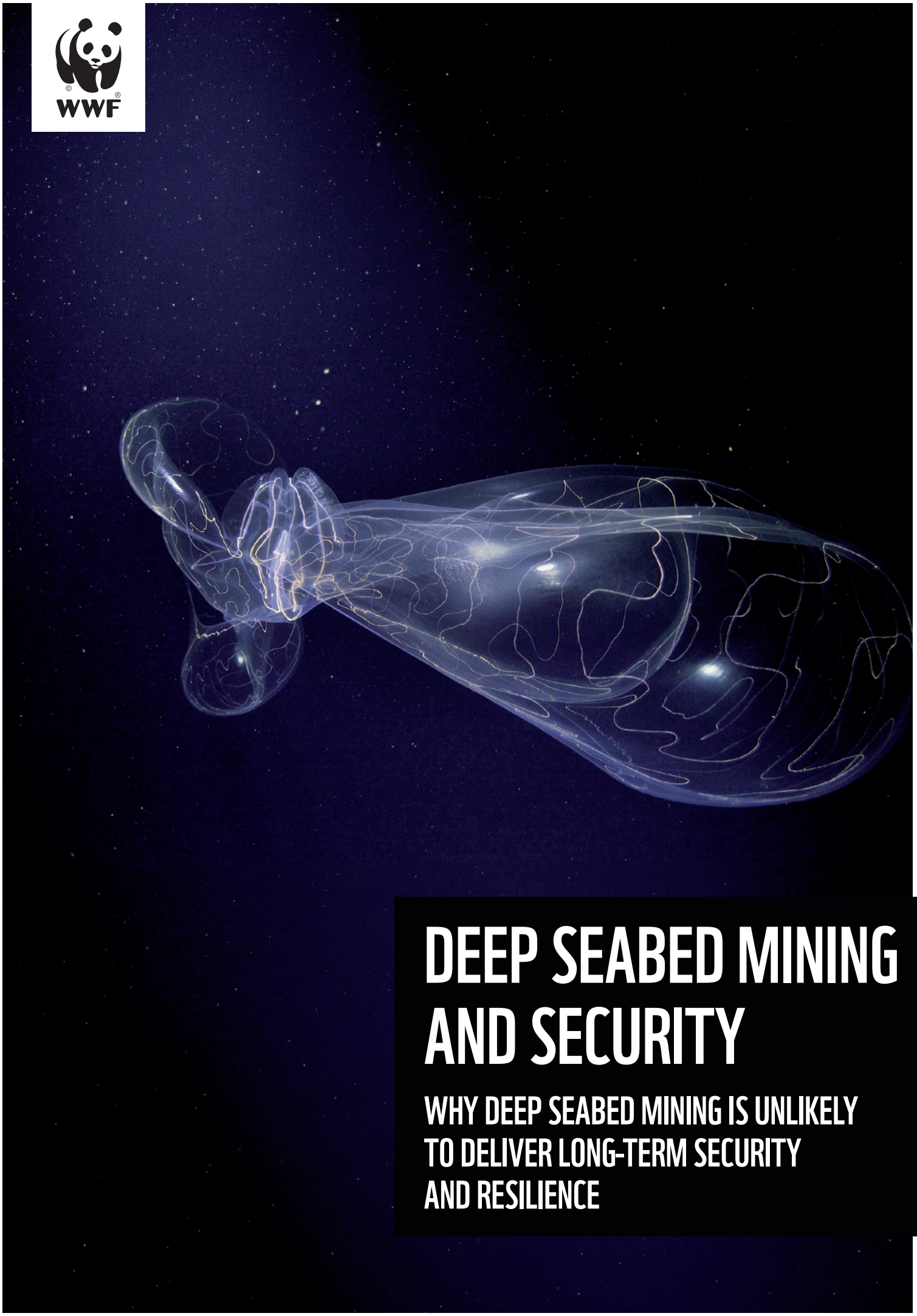

DEEP SEABED MINING AND SECURITY

WHY DEEP SEABED MINING IS UNLIKELY TO DELIVER LONG-TERM SECURITY AND RESILIENCE

Text by Martin Webeler, WWF
Based on research conducted by the German Institute for Global and Area Studies (GIGA), July 2026
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WHY DEEP SEABED MINING IS UNLIKELY TO DELIVER LONG-TERM SECURITY AND RESILIENCE – AND WHAT POLICYMAKERS SHOULD DO INSTEAD

This briefing draws on findings from research conducted by the German Institute for Global and Area Studies (GIGA) on the relationship between deep seabed mining and security, alongside additional evidence on critical minerals, technological innovation and ocean governance[1].

KEY MESSAGES

- Deep seabed mining (DSM) is increasingly promoted as a means of strengthening resource security, strategic autonomy and industrial competitiveness, but it is unlikely to eliminate the strategic dependencies that shape today's critical mineral supply chains.
- Even if extraction becomes technically feasible, major vulnerabilities would remain concentrated in refining, processing, logistics, technology and finance.
- DSM may create new risks, including governance instability, ecological disruption, financial exposure and technological lock-in. Governance legitimacy, ecological stability, scientific credibility, regulatory predictability and trusted international institutions are themselves strategic assets that underpin long-term security.
- Rushing to complete regulations despite scientific uncertainty and a lack of institutional consensus may further weaken confidence in multilateral governance systems, particularly when these efforts are seen as prioritising potential short-term gains over long-term environmental stability.
- Circular economy strategies, including recycling, substitution, material efficiency and demand reduction, offer more durable pathways for reducing dependency and strengthening long-term resilience.
- A precautionary pause or moratorium on DSM can be understood as an active security choice that reduces exposure to irreversible risks while enabling stronger governance and scientific understanding of the deep sea.

DEEP SEABED MINING'S SHIFTING NARRATIVE: FROM "CLIMATE SOLUTION" TO "SECURITY STRATEGY"

Deep seabed mining (DSM) has for years been promoted by its advocates as a necessary source of minerals for the energy transition from fossil fuels to batteries and renewable energy technologies. Now, in the face of persistent challenges to that assumption, the argument has begun to shift. Proponents increasingly argue that extracting minerals from the deep seabed could reduce dependency on concentrated supply chains, strengthen industrial competitiveness and provide greater strategic autonomy.

However, DSM is unlikely to deliver these promised security benefits, and may instead create new economic, ecological and governance vulnerabilities.

DEEP SEABED MINING WILL NOT ELIMINATE STRATEGIC DEPENDENCIES

The security case for DSM overlooks that extraction represents only one part of a much larger supply chain, and relies on an overly optimistic assessment of technological and commercial feasibility.

Even if DSM were to expand supply and diversify the geographic origin of some minerals, many of today's strategic dependencies would remain. Processing, refining, specialised technologies, maritime logistics, industrial infrastructure and financing systems are already highly concentrated and would continue to shape global mineral markets. Even pilot processing facilities are

1. https://doi.org/10.57671/hernandez-entangleddepths-26

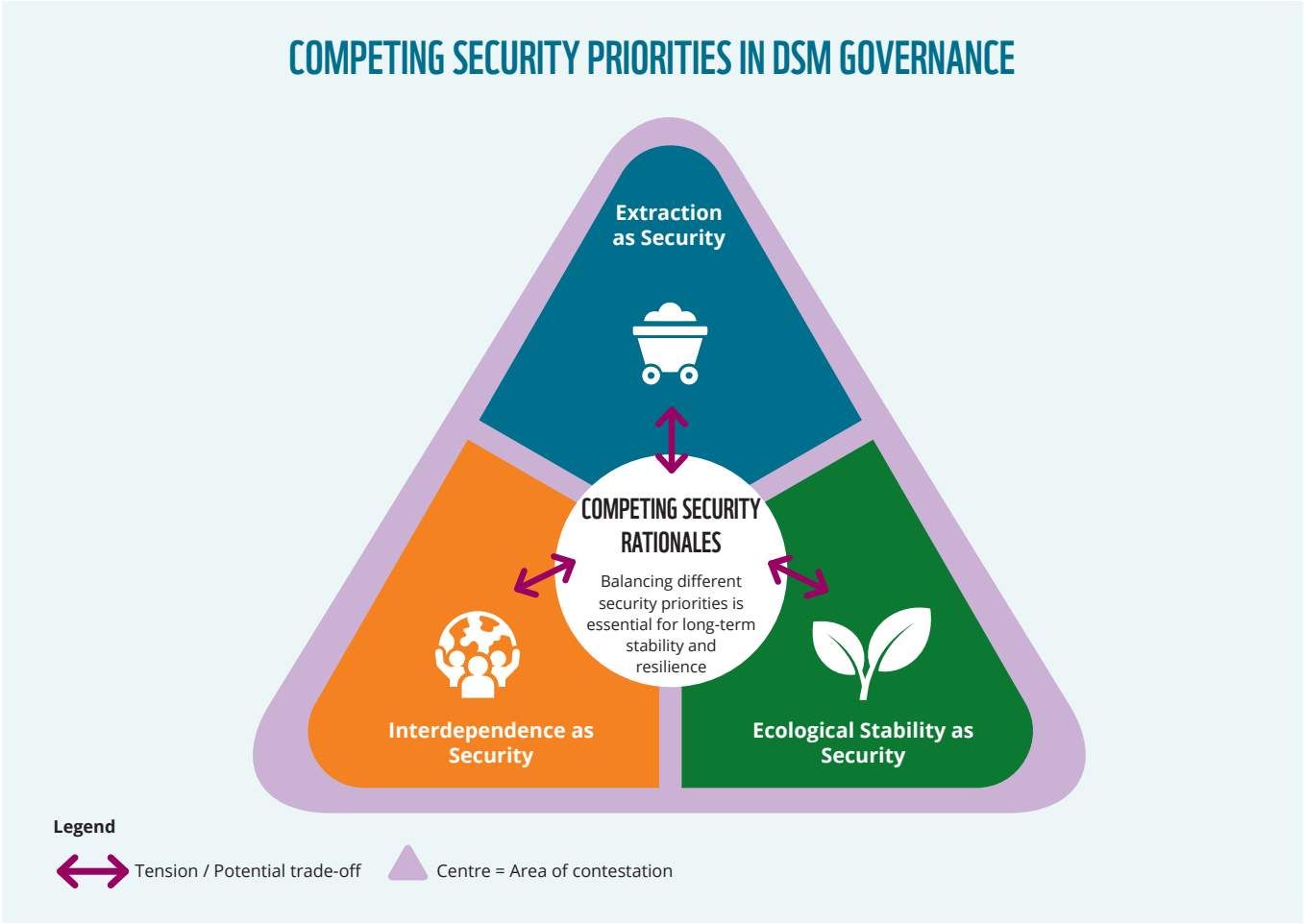


Figure 1

estimated to require a minimum of three to five years to establish, while commercial refining systems and integrated supply chains may take a minimum of one to two decades and require investment ranging from several billion US dollars to tens of billions, depending on scope and processing capacity.

What's more, the emphasis on strategic urgency may have the unintended consequence of undermining the multilateral governance systems required for long-term maritime stability. While DSM is increasingly framed by its proponents as geopolitically necessary, competition over seabed resources is already triggering political and regulatory fragmentation – even before DSM is commercially viable.

The securitisation of DSM, reinforced through scarcity and inevitability narratives, may increase the willingness of governments to overlook economic inefficiencies, ecological risks and social costs. At the same time, these narratives raise questions about whose security is prioritised, whose vulnerabilities increase and who bears long-term ecological and financial liabilities.

DEEP SEABED MINING MAY CREATE NEW ECONOMIC AND FINANCIAL VULNERABILITIES

The economic case for DSM remains highly uncertain.

Commercial-scale processing systems for deep-sea minerals do not yet exist. Building the required industrial infrastructure would require substantial investment, technological development and long implementation timelines. The risk of industrial lock-in and stranded assets increases once large-scale investments in extraction vessels, offshore systems, processing facilities and logistics infrastructure are made. Such assets may prove difficult to repurpose if or when technologies, mineral demand or regulatory conditions shift.

This means, instead of reducing vulnerability, DSM may create new forms of fiscal exposure, stranded asset risk and dependence on long-term state support. States with limited bargaining power and regulatory capacity would likely bear the highest burden of financial and governance risks.

Fundamentally, policymakers and investors need to ask, is it already too late for DSM? Business models depend heavily on assumptions about future mineral demand, commodity prices and battery technologies. While it's true that batteries have been a key driver of mineral demand, that picture is changing rapidly. Case in point: lithium-iron-phosphate

batteries, which do not require nickel, manganese or cobalt, represented more than 55% of global EV batteries deployed in 2025, up from nearly 50% in 2024 and around 15% in 2021. At the same time, battery recycling, material substitution and alternative battery chemistries continue to advance.

COOPERATION IS A SECURITY STRATEGY

Security is not only shaped by markets and resources. It also depends on trusted institutions capable of managing competition, uncertainty and shared resources. Governance legitimacy, scientific credibility, regulatory predictability and public trust are themselves strategic assets. Weakening them in pursuit of accelerated extraction – even if supposedly in support of the "green transition" – may ultimately erode confidence in multilateral institutions, undermining the cooperation and predictability on which long-term security and stability depend.

The deep seabed in the international waters, designated as the common heritage of all humankind, is governed through international frameworks established under the United Nations Convention on the Law of the Sea (UNCLOS). These institutions were designed to ensure that activities in the global commons are conducted cooperatively, transparently and in accordance with environmental obligations.

Rushing to adopt the Mining Code or circumventing regulatory processes before scientific uncertainties are resolved and governance systems are fully developed risks undermining these objectives. Efforts to mine international waters without global consent and approval of the International Seabed Authority would set a dangerous precedent and undermine the force of the multilateral framework. Maintaining its credibility requires that states uphold and implement all relevant UNCLOS obligations, including Article 145 and Articles 137–139.

Trust and legitimacy are strategic assets. Where decision-making is seen to prioritise resource access and potential short-term profits over environmental health or meaningful participation by all stakeholders, confidence in both DSM projects and multilateral institutions may be eroded. This is particularly relevant given strong and growing concerns among scientists, Indigenous Peoples, UN human rights experts, the corporate and finance sector, fisheries organisations and civil society groups regarding the pace and direction of DSM governance.

DSM increasingly functions as a stress test for the rules-based maritime order and wider biodiversity and climate governance systems. It's therefore vital that strong international institutions be understood as strategic assets rather than obstacles to be overcome.

ECOLOGICAL STABILITY IS A SECURITY ASSET

Marine ecosystems support food security, fisheries, climate regulation, economic stability and the livelihoods of millions of people. These functions form part of the underlying infrastructure upon which societies depend.

Significant scientific uncertainty remains regarding the cumulative impacts of DSM on deep-ocean ecosystems, their functions and services – including nutrient cycling and carbon storage – but it is likely the impacts will be large-scale and irreversible. Ecological disruption associated with DSM could therefore act as a risk multiplier, amplifying existing pressures on food systems, coastal economies and climate resilience.

The distribution of risks and benefits also raises important governance questions. While any potential financial gains may accrue primarily to contractors, investors and industrialised economies, ecological and social impacts may be borne disproportionately by developing countries and ocean-dependent populations.

BUILDING RESILIENCE THROUGH CIRCULAR ECONOMY PATHWAYS

If the objective is long-term resilience, there are viable alternatives that don't include DSM.

Circular economy strategies aim to reduce structural dependency by lowering material demand, extending product lifetimes, increasing recycling, improving resource efficiency and supporting material substitution. Rather than seeking security primarily through expanding extraction, **they seek to reduce vulnerability at its source**.

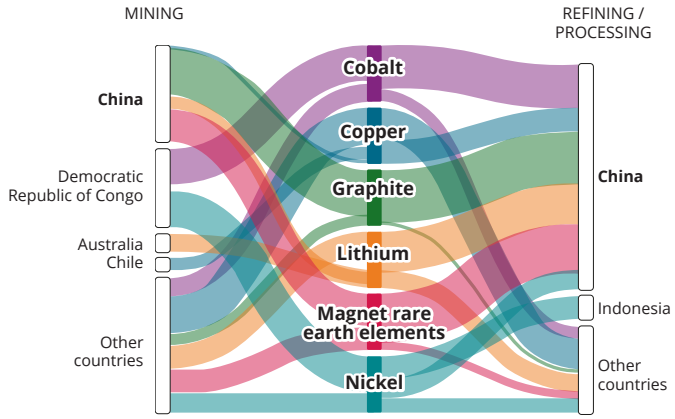
Recent research increasingly suggests that circular economy pathways could significantly reduce future demand for primary minerals while strengthening industrial resilience and reducing exposure to concentrated supply chains.

Circular economy pathways won't materialise on their own. These approaches require investment, regulation, innovation and international cooperation. Countries face a stark choice: continue pumping investments into a linear, extractive economic model that is volatile and offers limited long-term security, or build a circular economy that prioritises resilience and reduces harmful dependencies, environmental risks and geopolitical vulnerability.

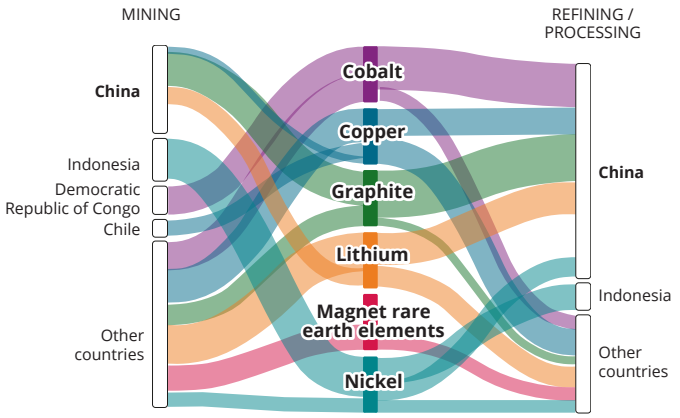
Importantly, circular economy strategies are more than environmental window dressing. **They are robust industrial, economic and security policies that may reduce the need for virgin critical minerals more rapidly than entirely new extraction systems can be developed.**

Critical minerals: country roles in mining and refining, 2025

China dominates refining and processing for several critical minerals even when mining is geographically more dispersed.



Critical minerals: country roles in mining and refining 2040



Source: The Refining Bottleneck (2025 vs 2040), visualisation by Valencia, based on IEA (2025a)

Figure 2

A MORATORIUM IS AN ACTIVE SECURITY CHOICE

Calls for a precautionary pause or moratorium on DSM are sometimes portrayed as opposition to innovation and economic development, or as an environmental crusade.

In reality, they can be understood as active security strategies – strategies shared by 43 countries (as of June 2026), including small island developing state Palau and landlocked Malawi.

Implementing a precautionary pause or moratorium reduces exposure to irreversible ecological disruption, technological lock-in and governance instability while allowing time to strengthen scientific understanding, monitoring capacity and regulatory frameworks.

It preserves policy flexibility in the face of significant uncertainty and avoids committing societies to pathways that may ultimately prove environmentally, economically or strategically unsustainable.

In conditions of high uncertainty, precaution is not the opposite of security. It is a core component of security.

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RECOMMENDATIONS FOR POLICYMAKERS

1. Prioritise long-term resource security and ecological and economic resilience by investing in circular economy approaches, including material efficiency, reuse and recycling.

2. Strengthen multilateral governance: engage in multilateral fora like the International Seabed Authority and ensure that decisions regarding deep seabed mining are grounded in transparency, sufficient scientific evidence, precaution and meaningful public participation.

3. Reinforce trust in multilateral systems: ensure full adherence to UNCLOS obligations, including Article 145, Article 154 and Articles 137-139, and refrain from adopting a Mining Code until sufficient scientific knowledge is available to guarantee effective protection for the marine environment from harmful effects from deep seabed mining.

4. Apply the precautionary principle to avoid creating new ecological, economic and societal vulnerabilities that may undermine long-term resilience, food security and sustainable livelihoods.

5. Join the call for a global moratorium or precautionary pause on deep seabed mining, and attend International Seabed Authority meetings and other relevant fora to call for the adoption of a moratorium or precautionary pause on deep seabed mining as a matter of urgency.

The central question is not whether societies can access more minerals. It is whether they can strengthen resilience without creating new ecological, economic and geopolitical vulnerabilities.

The evidence increasingly suggests that reducing dependency through circular economy pathways, while maintaining precaution and prioritising sufficient scientific information in the face of uncertainty, offers a more durable foundation for long-term security than opening a new extractive frontier in the deep ocean.

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