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TAG Spotlight: Industry Risks and Responses to China's Export Controls on Critical Minerals and Rare Earths

'No.3 pegmatite', the world's largest mining pit with 84 different kinds of mineral deposits in Altay Prefecture, Xinjiang Uygur Autonomous Region of China, on June 7, 2024. (Photo: Wang Jian/VCG via Getty Images)

Key Takeaways

- **Critical Minerals Have Become the Flashpoint to Watch in the U.S.-China Trade War:** The latest round of U.S.-China negotiations in London has renewed focus on the fragility of global mineral supply chains and the strategic risks posed by China's dominance in processing. Even with signs of de-escalation, the talks highlight how critical mineral dependencies remain a structural vulnerability for the United States. In April 2025, Beijing issued Announcement 18, a direct response to U.S. tariffs that introduced tight controls on exports of seven rare earths and minerals critical to the production of advanced defense equipment and clean technologies. Although last month's U.S.-China trade talks in Geneva paused further escalation, signs are pointing toward some easing on U.S. buyers following last week's Trump-Xi call. However, critical mineral curbs remain Beijing's key point of negotiation leverage.

- **China's Controls are Constricting Global Supply Chains:** Beijing's new restrictions on the export of critical minerals and rare earths – imposed in retaliation for U.S. tariffs – are creating major disruptions across multiple sectors including technology, telecommunications, energy, and defense. First introduced in 2023 and accelerated in early 2025, the regulations include licensing requirements, volume caps, and other restrictions that limit international availability – resulting in price volatility, production slowdowns, and financial strain for downstream manufacturers.

- **Resource Nationalism Compounds Supply Chain Uncertainty:** Even prior to the current trade war, Beijing began restricting raw mineral exports to boost domestic manufacturing and support China's value-added industries. China's dominant position in mineral refining, combined with its additional restrictions on rare earth elements and tungsten, has accelerated the global move toward tighter controls. Other mineral-rich countries have now adopted similar strategies, indicating an increasingly protectionist, structural realignment in critical mineral supply chains that is likely to persist regardless of any future U.S.-China détente.

- **Companies Must Strengthen Operational Resilience:** The current environment leaves multinational firms with little room for delay. To avoid disruption from China's export controls, multinational companies face a critical window for diversifying their sourcing, exploring material substitution, strategic stockpiling, and investing in recycling infrastructure.

What You Need to Know

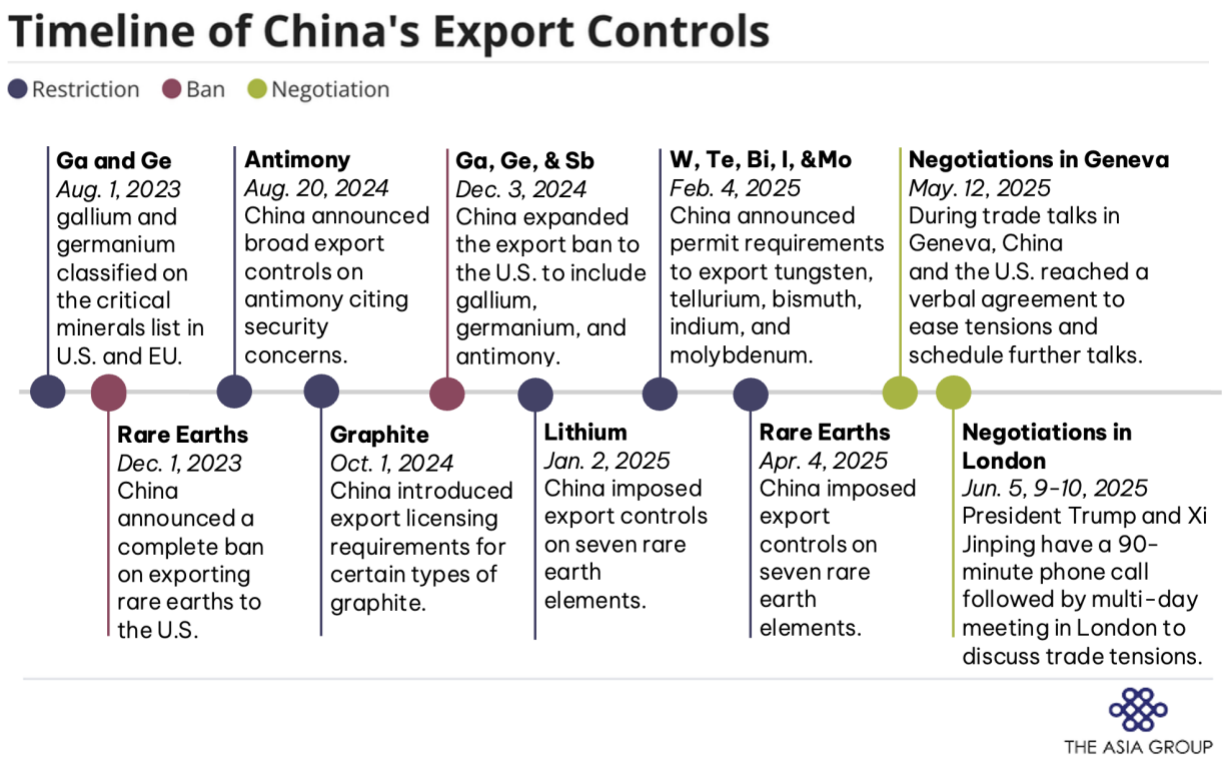

Figure 1

- **China has been steadily expanding restrictions on critical minerals long before its most recent wave of export curbs (see Figure 1, above).** In July 2023, Beijing introduced licensing requirements on gallium and germanium exports, citing national security concerns. These restrictions expanded further in January 2024 to include lithium carbonate, a key input in battery production. By early 2025, Beijing also imposed new quotas on these minerals, further reducing international supply and exacerbating supply chain bottlenecks. The restrictions hit lithium markets hardest, with downstream producers in the electric vehicle and grid storage sectors in North America and Europe reporting delays in sourcing refined lithium hydroxide, leading to production setbacks and stalled rollout timelines.

- **Beijing's restrictions underscore the vulnerabilities associated with global reliance on China for critical mineral refining** (see Figure 2, below). The exposure of high-tech sectors to supply chain chokepoints has highlighted the urgency with which firms are now seeking more diversified and resilient sourcing models.

For example, following China's initial July 2023 announcement on gallium and germanium, gallium prices surged by more than 30 percent. Manufacturers dependent on gallium arsenide and gallium nitride technologies for high-speed computing, radar, and 5G infrastructure experienced immediate cost inflation and procurement challenges. Semiconductor fabrication plants, particularly in Taiwan, South Korea, and the United States, reported material flow disruptions that led to contract renegotiations and scheduling delays.

Meanwhile, germanium prices rose by over 56 percent — from USD 1,350–1,400 per kilogram to USD 2,100–2,200 per kilogram by July 2024. This spike prompted defense contractors and telecommunications firms to reassess procurement strategies, initiate early contract renewals, and draw down emergency stockpiles where available.

- **The April 4 rare earths restrictions marked a significant escalation and highlight Beijing's growing use of mineral policy as a tool of trade retaliation.** Companies and governments alike must prepare for a future in which access to critical minerals is no longer just a commercial priority but a geopolitical flashpoint.

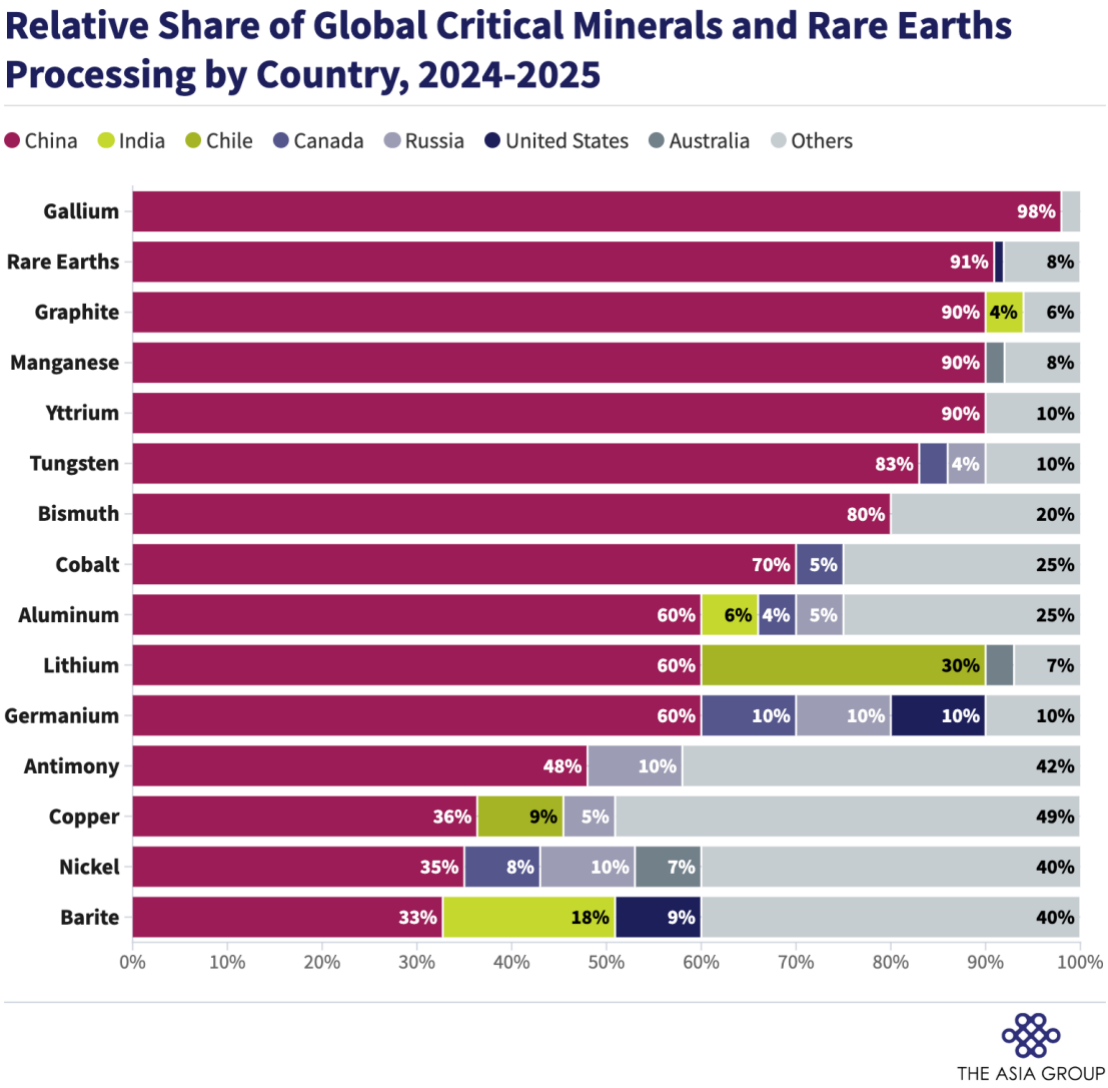

Figure 2

Impact on Suppliers and Consumers

SUPPLY CHAIN, SOURCING, AND REFINING CHALLENGES

- **Supply chains are likely to face disruptions:** Industries such as aerospace, defense, electric vehicle manufacturing, telecommunications, and semiconductor fabrication — many of which rely heavily on rare earths, gallium, germanium, and lithium —are particularly vulnerable given China's near-monopoly on global processing capacity. Downstream industries, including vehicle manufacturers, solar panel producers,

telecommunications firms, and aerospace and defense contractors, across North America, Europe, and Asia have been forced to accelerate contingency planning, reevaluate sourcing dependencies, and brace for continued volatility across strategic mineral markets.

- **Alternative sourcing is desirable but sustainable production remains a challenge:** Increased production of gallium and germanium in Germany, Japan, Kazakhstan, and Canada alongside lithium project expansions in Australia, Canada, and Argentina could help alleviate supply constraints. The U.S. government is actively seeking new supply partnerships with countries like Ukraine and Pakistan. While these markets are promising, they are often challenged by weak infrastructure, political instability, and Chinese competition. Seabed mining has emerged as another prospective source of critical minerals, but it brings significant environmental, legal, and technical challenges that make near-term deployment unlikely. Overall, political risk, permitting bottlenecks, and geopolitical competition will continue to complicate efforts to secure reliable alternative supply.

- **Lead time for developing new sources and refining capabilities are long:** While countries like Australia, Canada, Germany, and Japan possess viable reserves and are expanding refining capabilities, most still require significant investment to develop the infrastructure necessary for large-scale processing and purification, which includes not only processing and manufacturing know-how but also specialized rare earth processing technologies. The process is slow as securing environmental permits; constructing facilities, and meeting regulatory standards often takes years on top of other technical constraints.

- Notably, the United States has made progress in pursuing alternative processing and refining capabilities. Trump's EO 14241 ("Immediate Measures to Increase American Mineral Production") issued on March 20, 2025, mandates that U.S. Federal agencies identify and fast-track priority mineral production projects on critical mineral-rich Federal lands. It also unlocks Defense Production Act (DPA) authorities and low-interest financing to streamline permitting and development. These measures mark a major drop in bureaucratic barriers compared to EO 13953 ("Addressing the Threat to the Domestic Supply Chain from Reliance on Critical Minerals from Foreign Adversaries") from Trump's first term.

  Nevertheless, the pace and impact of alternative sourcing will depend on rigorous implementation, interagency coordination, legal challenges, and

congressional funding. Thus, while the latest EO improves prospects for faster deployment, structural obstacles still mean most new refining projects remain years from completion.

OTHER VARIABLES

- **Resource nationalism and localization policies are likely to shift global supply chains independent of U.S.-China strategic competition:** Some countries with viable reserves of gallium, germanium, or lithium are implementing "value-add" policies that restrict the export of raw materials and instead require local processing. In cases like Indonesia's nickel sector, Chinese companies who dominate the global nickel processing industry have been able to comply with onshoring mandates because the smelting infrastructure is relatively straightforward to build with adequate financing.

  However, in more specialized markets such as rare earths (which require complex chemical separation facilities and highly trained labor), such mandates often deter investment entirely. This evolving landscape of resource nationalism, including higher royalties and in-country processing mandates, limits global access to critical minerals and forces buyers to navigate increasingly fragmented and protectionist frameworks.

- **Advancements in recycling and new technologies will play a decisive role in reducing dependency on critical minerals:** Advances in recycling efficiency and breakthroughs in sustainable material recovery will also help strengthen supply chain resiliency. Meanwhile, battery innovations, such as commercial-scale production of non-lithium EV and energy storage solutions, could reduce pressure on lithium demand. As many of these technologies are still nascent and experimental, however, it will take time before they are widely distributed and reliably utilized.

- **The Global Energy Transition depends on continuous access to vital materials:** The minerals and rare earths targeted by China's export restrictions are not only essential to advanced manufacturing and national security, but also pivotal to the global energy transition. Technologies such as electric vehicles, solar panels, wind turbines, and grid-scale batteries depend on materials like gallium, graphite, lithium, and tellurium — several of which appear in the quadrant of highest concern in Figure 3 (below).

As governments worldwide accelerate decarbonization plans, competition for secure and diversified mineral supply is intensifying — bringing geopolitical risk directly into the core of global climate strategy. This reinforces the urgency of investing in diversified sourcing, processing, and recycling infrastructure — not just in the United States, but across the international energy economy.

Figure 3

Strategies for Exposure Mapping and Adaptation

There are several strategies multinational companies can employ to both assess and help mitigate exposure to disruptions in critical mineral and rare earth supply chains.

- **Assess exposure to expanded geopolitical risk:** A thorough review of supply chain exposure to Chinese critical minerals includes not only primary sourcing and refinement stages but also ownership and control risks — such as joint ventures or suppliers with foreign entity of concern (FEOC) ties under emerging U.S. policy. Assessments should also factor in related vectors of uncertainty including the U.S.-China trade war, technology export controls, and resource nationalism. China will likely continue to leverage critical mineral export controls as an oft-utilized form of retaliation against U.S. export controls, the ongoing threat of reciprocal tariffs, and targeted investigations (e.g., Section 232 probe into copper, semiconductors, and other goods).

- **Closely monitor procurement:** Decisions by agencies like the U.S. Defense Logistics Agency and the EU Raw Materials Alliance can also shift the market. When these bodies purchase reserves, launch joint procurement, or make strategic designations, they influence availability and pricing and often determine who gets early access to constrained supplies. To stay competitive, companies must closely track these signals, anticipate demand spikes, and align procurement strategies accordingly.

- **Consider alternative government sourcing:** Some companies are exploring material substitution, such as the growing use of silicon carbide in place of gallium in semiconductors, to reduce long-term dependency on vulnerable inputs. At the same time, investment in recycling technologies, especially in countries like Japan, is proving essential in recovering critical minerals from end-of-life products. Finally, governments and firms are expanding strategic stockpiles to manage volatility and buffer against supply shocks.

- **Leverage existing policy platforms:** To build resilient and diversified supply chains, firms must evaluate a range of strategic responses beyond simply identifying alternative suppliers. Viable geographic alternatives require

more than mineral reserves; they need refining capacity, export willingness, recycling infrastructure, and favorable policy environments.

As programs like CHIPS and the Inflation Reduction Act face political uncertainty, firms should identify other U.S. and international policy mechanisms — such as the Mineral Security Partnership (MSP), Clean Energy Ministerial forums, or OECD export dialogues — that can offer support in the form of technical coordination, co-investment opportunities, diplomatic pressure, and regulatory alignment.

- **Ramp up proactive and purposive stakeholder engagement:** Leverage advocacy opportunities via trade associations and engaging government stakeholders on bilateral critical mineral agreements, expanded strategic stockpiles, or streamlined permitting in allied countries. Utilizing these platforms can amplify private sector needs and shape policy agendas that reduce long-term supply chain risk.

See Appendices I and II (below) for a mineral-by-mineral breakdown on geographic alternatives, substitution options, and stockpiling status.

This report was prepared by Kamiryn Rose-Weinberg and the TAG Geopolitics & Research Team.

APPENDIX 1: RESTRICTED MINERAL EXPORTS

MINERAL	GEOGRAPHIC ALTERNATIVES	SUBSTITUTION OPTIONS	STOCKPILING STATUS
GRAPHITE	**Sourcing:** Canada (Northern Graphite) and Mozambique are increasing production. **Largest Reserves:** - **Turkey:** 90 million mt - **Brazil:** 70 million mt - **China:** 73 million mt	**Watchpoint:** Silicon-based anodes are being explored as alternatives in lithium-ion batteries. **Recycling:** Recovery from anode materials during battery disassembly and chemical processing.	**U.S. Stockpile:** No public data
LITHIUM	**Sourcing:** Australia, Chile, and Argentina are the top producers; the U.S. is investing in Nevada's Thacker Pass lithium mine. **Largest Reserves:** - **Chile:** 9.2 million mt. - **Australia:** 4.7 million mt - **Argentina:** 2 million mt	**Watchpoint:** Sodium-ion and solid-state batteries are being explored as lithium alternatives. Calcium, magnesium, mercury, and zinc as anode material in primary batteries. **Recycling:** Hydrometallurgical processing of used batteries; pyrometallurgical smelting	**U.S. Stockpile**: - Lithium Ion – LCO: 752 kg - Lithium Ion – LNCA: 2,698 kg - Lithium Ion – MCMB: 2,205 kg
BISMUTH	**Sourcing:** Canada and Bolivia are emerging as alternative suppliers. **Largest Reserves:** - **China:** 240,000 mt. - **Bolivia:** 10,000 mt.	**Watchpoint:** Tin and other non-toxic alternatives are being explored for bismuth applications in pharmaceuticals and alloys. **Recycling:** Limited efforts exist, though some bismuth recovery occurs from lead recycling.	**U.S. Stockpile:** No public data
TUNGSTEN	**Sourcing:** The U.S., Vietnam, and Australia are expanding tungsten mining. **Largest Reserves:** - **China:** 1.9 million mt.	**Watchpoint:** Potential substitutes for tungsten carbides include cemented carbides based on molybdenum carbide, niobium carbide, or titanium carbide;	**U.S. Stockpile:** - Tungsten Ores & Concentrates 13,237,580 kg - Tungsten Rhenium Ingots 5,001 kg

	- **Russia:** 400,000 mt.	ceramics; ceramic-metallic composites. **Recycling:** Scrap tungsten from cutting tools and military applications is recovering at increasing rates.	
INDIUM	**Sourcing:** Japan and Canada are investing in domestic indium production. **Largest Reserves:** - **China:** 1,200 mt - **Peru:** 620 mt	**Watchpoint:** Graphene and carbon nanotubes as potential substitutes in display technologies. **Recycling:** Indium recovery from end-of-life LCD screens is a growing industry.	**U.S. Stockpile:** No public data
MOLYBDENUM	**Sourcing:** The U.S. and Chile have significant molybdenum mining operations. **Largest Reserves:** - **China:** 4.3 million mt - **USA:** 2.7 million mt - **Chile:** 1.8 million mt	**Watchpoint:** Potential substitutes include boron, chromium, niobium, and vanadium in alloy steels; tungsten in tool steels; graphite, tantalum, and tungsten. **Recycling:** Molybdenum is recycled as a component of catalysts, ferrous scrap, and superalloy scrap.	**U.S. Stockpile:** No public data
TELLURIUM	**Sourcing:** The U.S. and Canada are developing domestic tellurium production. **Largest Reserves:** - **Peru:** 6,000 mt - **USA:** 3,500 mt	**Watchpoint:** Selenium can replace tellurium in some solar panel applications. Amorphous silicon and copper indium gallium diselenide are the two principal competitors in solar cells. **Recycling:** For traditional metallurgical and chemical applications, there was little or no scrap from which to extract secondary tellurium.	**U.S. Stockpile:** No public data

APPENDIX 2: BANNED MINERAL EXPORTS

MINERAL	GEOGRAPHIC ALTERNATIVES	SUBSTITUTION OPTIONS	STOCKPILING STATUS
RARE EARTH ELEMENTS (REES)	**Sourcing:** The U.S., Australia, and Canada are expanding the Mountain Pass mine (California) and Australia's Lynas Rare Earths Mine. **Largest Reserves:** - **China:** 44 million mt - **Vietnam:** 22 million mt - **Brazil:** 21 million mt	**Watchpoint:** Researchers are developing REE-free electric motors and wind turbines. **Recycling:** Limited recovery from e-waste and industrial magnets; hydrometallurgical separation is under study.	**U.S. Stockpile:** No public data
GERMANIUM	**Sourcing:** The United States, Canada, Belgium, Germany, Finland, produce germanium as a byproduct of zinc mining. **Largest Reserves:** - **China:** 3,500 mt - **Russia:** 1,000 mt	**Watchpoint:** Silicon and gallium-based semiconductors are alternatives in some applications. **Recycling:** Germanium recovery from fiber optics and infrared optics via chlorination and distillation is growing.	**U.S. Stockpile:** - Germanium Metal – Intrinsic: 14,047 kg - Germanium Wafer: 68,671 ea. - Germanium Scrap: 6,905 kg
GALLIUM	**Sourcing:** Germany, Japan, Kazakhstan, Canada, and South Korea are investing in gallium production outside of China. **Largest Reserves:** - **China:** 300,000 mt - **Ukraine:** 100,000 mt	**Watchpoint:** Silicon carbide (SiC) and indium phosphide are possible alternatives to semiconductors. **Recycling:** Gallium recovery from semiconductors and LED waste by acid leaching and electrolysis is growing.	**U.S. Stockpile:** - Data not publicly disclosed
ANTIMONY	**Sourcing:** The U.S. (Idaho's Perpetua resources) and Tajikistan **Largest Reserves:** - **China:** 480,000 mt - **Russia:** 350,000 mt - **Bolivia:** 310,000 mt	**Watchpoint:** Tin and polymers are being explored as substitutes for flame retardants. **Recycling:** Antimony can be recovered from lead-acid battery paste and flame-retardant materials.	**U.S. Stockpile:** 198,763 lb.