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Chinese mining history informs modern global critical minerals geopolitics

Oral Inquiry: Critical Minerals

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I am a specialist in critical metals production and supply, which is strongly impacted by the Chinese monopoly on mining and processing for strategic commodities. In this submission, I refer to questions posed for the oral evidence relating to China and critical minerals, specifically the following:

1. What is China's role at each stage of the supply chain and what does it mean for the UK?
2. What are the policies that have enabled China to achieve this?
3. How has China turned control of CMs into industrial advantage?
4. What is the likelihood that China will use dependencies against the UK and what will its impact be?
5. What lessons can we learn about international responses to critical minerals risks and opportunities, and how can they help us work with other countries?

Executive Summary

Chinese policies to achieve critical minerals dominance targeted the domestic economic landscape before international relations. China emerged from a history of challenging international relations with minerals processing technological superiority and domestic regulation of the scales of mining, which combined to support centralised control of its domestic resources. This domestic success was successfully replicated in overseas mining operations that fed many critical minerals supply chains that have China as a processing and refining hub.

China enters into collaboration with supply chain and technology development partners, while protecting its technological advantages and economic position. Effective engagement of UK with China can be informed by understanding Chinese mining history and how it relates to modern collaborations. China has used critical minerals supply as leverage in Asian geopolitics and, when provoked, in vigorously defending its global economic position as the premier global producer of critical raw materials. China has not colonised supplier (mining) nations through debt-trap policies but Chinese companies operate within overseas national guidelines rather than applying the more stringent mining regulations that are being enforced in China.

While China can be a reliable partner, geographical concentration of processing and refining in China poses risks for the UK. The risks stem either from the possibility of disruption at single sites or from tensions that arise due to third country allegiances and tensions. Alternative supply chains should be developed, with a focus on processing and refining in countries with sufficient feedstocks

to build local value addition, to mutual benefit between producer and consumer countries. Key questions are finally listed, to support reshaping of supply chains.

1 What is China's role at each stage of the supply chain and what does it mean for the UK?

China dominates primary production, processing and refining, and secondary production of critical minerals.

China holds some of the most lucrative ore deposits for primary production by mining of commodities such as tungsten, graphite and rare earth oxides (REO). Although large ore deposits of these commodities are elsewhere, China effectively undercut the cost of production from mines in other countries through the late 20th to early 21st century.

REO are a commodity of note. China holds the only giant ore deposit producing REO in the world[1]. Chinese global REO production increased from less than 40% of prior to 1992, to 90% in 1998, with a peak at 98% in 2009. Diversification strategies that were designed to mitigate open markets economics by opening or reopening other mines, reduced Chinese production by primary mining to 60-70% in the 2020s.

The new mines outside of China have not reduced supply chain dependence due to the processing and refining sectors that remain in China. The geographic concentration of refining has increased across nearly all critical minerals, particularly key energy minerals nickel (Indonesia dominates) and cobalt, graphite and REO (China dominates)[2]. By-product commodities are extracted during the refining of concentrates of other (mined) metals concentration so that their supply is also concentrated in refining hubs. Examples are gallium and germanium (approx. 99% and 60% respectively from China).

Concentration of refining and processing in China is reinforced by China's monopoly on critical metals production in other countries. For example, only a small amount of cobalt (1%) is mined in China, but China controls 46% of global cobalt production because Chinese mining operations dominate in DRC. China's stronghold extends beyond refining; two-thirds of global battery recycling capacity growth since 2020 has been in China. Key metals are cobalt, lithium, graphite and REE.

The UK is dependent on Chinese imports and loses mineral wealth from its economy by export to China.

The UK produces few of the raw materials that it needs. Examples are:

- The feedstock for **synthetic graphite** at the Humber refinery is exported at low relative value to China for processing. Refined graphite is imported at higher value, so there is a net loss of mineral wealth from the UK economy.

[1] https://www.sciencedirect.com/science/article/pii/S1674987116000037
[2] https://www.iea.org/reports/global-critical-minerals-outlook-2025/executive-summary

- Sizeable ore deposits of **tungsten, tin and lithium** are close to operation in southwest England. The US, in seeking to reduce dependence on China, has investment interest in tungsten for export from UK as concentrate, which will also be at relatively low value.
- Planned **REO** processing and alloying capacity has been lost to the US. Pensana Ltd will now be and Less Common Metals (acquired by USA Rare Earth) are relocating to South Carolina and Oklahoma, respectively. Hypromag is expanding in the US as well as scaling up in the UK.

UK has prospective and emerging capability in secondary refining, though it cannot scale up effectively until sufficient technologies come to their end of life in use. The companies are in the early stage 'valley of death' reliance on initial capex. Vulnerability has been mitigated to some extent (e.g. for Altilium) by the award of scale up funding from the Advanced Propulsion Centre.

There are some key opportunities to develop greater resilience and independence.

- Whole value chains need integrating and diversifying outside of China, not just the production by mining.
- The range of commodities that are impacted by supply security issues mean that vertical integration in the UK can happen only for specific commodities and friendshoring will be essential.
- While furthering international partnerships, UK should safeguard against losing knowledge and capacity to established partners such as US.
- Knowledge and capacity development need support in the UK, for integrated mineral wealth retention, to navigate the valley of death, and to limit relocation of innovative companies.

2 What are the policies that have enabled China to achieve dominance?

The overarching approach of 'taking control' of resources stems from the past international relations[3], tied to incursions on Chinese (mineral) territory in military and industrial strategies.

Key points in the historic critical mineral timelines are:

Historic	China globally leading technology development for iron and steel production: pioneering metallurgy with cast-iron, blast furnaces; hardened steel production for armaments.
18th-19th centuries	China's historic dominance of steel declines, primarily due to the West flooding the market with cheaper iron and steel.
late 19th-20th century	Significant international (i.e. European nations, UK, US) exploration interest in Chinese ore deposits, particularly uranium, thorium and REO.
1949	UK and US interest in Chinese REO and radionuclide ores tied to nuclear defence capability ended with the communist revolution.
1951	The Baotou Iron and Steel complex was established as the industrial heartland of China and the region from which the REO were produced.

[3] https://www.sciencedirect.com/science/article/pii/S2590289X20300116

1950s-1960s	Collaboration with the Soviet Union to develop REO alloys tied to the space and arms races, meant that China became technologically superior in the rare earths sector.
1970s	The proliferation of digital technology use coincides with Chinese policy to capitalise on its resources and technological superiority.
1970s-1990s	Consumer nations focussed on higher value manufacturing sectors, leaving lower value mining and processing industries to other countries.
1990s +	China publicises policies to secure global industrial dominance based on vertically integrated supply chains.

The key policy period for critical minerals is from 1990 onwards, as evidenced by the rapid increase in the share of global REO production outline in section 1.

Domestic policies in China centralised control of mining, in the 1990s, to increase production.

Policies were created to classify small-scale rare earth miners as illegal and merge production into six large, state-owned enterprises (the "Big Six") to control supply and pricing. The key actions were: (1) China suspended the issuance of new mining licenses for rare earths in 1991; (2) Provincial authorities began massive, often violent, crackdowns on illegal, small-scale, and private mining operations, e.g. in Jiangxi, in 2011; (3) the Chinese Government launched an intensive nationwide campaign against illegal rare earth mining, smuggling, and "black market" production in 2016–2018.

REO production by large companies was environmentally damaging on larger and more rapid scales than prior mining, and the dispossession of small-scale miners reduced the equitable distribution of wealth from mining activities within rural communities. Internal domestic pressure in China regarding mining is driven primarily by the severe environmental degradation, health crises in mining communities, and social conflicts over land rights, forcing the central government to tighten environmental regulations.

Environmental Impact Assessments in China require (1) design, construction and operation of environmental protection facilities alongside mining projects), (2) environmental restoration, and (3) mining safety. By 2028, 90% of large-scale and 80% of medium-sized domestic mines must meet Chinese green mining standards. The shift towards centralized resource governance has an associated rise in domestic compliance costs. The strict enforcement has encouraged Chinese firms to shift investment overseas.

International policies have partly replicated past patterns of industrial dominance.

The Chinese State configured its international vision to continue growth, while domestic overproduction resulted in decreasing returns to capital and economic stagnation. Significant international policies are:

1999-2002	'***Go Global***': company-focussed strategy. It encourages domestic companies (especially State-Owned Enterprises) to invest overseas to secure natural resources, acquire technology, and improve global competitiveness. The strategy has evolved from focusing solely on resource acquisition to supporting more diverse forms of overseas investment, mergers and acquisitions.
2013	'***Belt and Road***': state-level, grand strategy to build geopolitical influence. It is premised on the resurrection of the Silk Road and the regional maritime security of the Ming Dynasty (1368-1644), with investment in 150 countries.
2015	'***Made in China 2025***': state-led industrial policy to transform China into a high-tech superpower, integrating innovation-driven manufacturing with low-cost production.
2020	**Dual Circulation Strategy** prioritizes domestic consumption and self-reliance (*internal circulation*) while keeping the economy open to foreign trade and investment (*external circulation*). It aims to reduce reliance on foreign technology and volatile export markets.
2021-2025	The most recent (5-year) **National Mineral Resources Plan** reflects policy, lists strategic minerals and energy resources, sustainable efficiencies, green development and circular economy. The critical minerals include gold, for financial security and reserves.
2024	Major revision to **Mineral Resources Law** (originally 1986) includes the **Mineral Resources and Emergency Response**, a legal framework for a national critical mineral stockpiling system and emergency mining.

China has been accused of debt-trap policy in its international investment strategy but China does not aggressively seize assets and tends to focus on further investment as a route out of debt risk[4]. At the company level, Chinese mining operators are replicating the pattern of dispossession of small-scale miners by legal and illegal means in overseas operations (e.g. Ghana[5]), to scale up production while short-changing the socioenvironmental costs of mining. The realities of Chinese investment and operations are variable across nations, scales of mining and commodities.

3 How has China turned control of CMs into industrial advantage?

There are six ways in which China has obtained control of global critical minerals production, and turned it into competitive industrial advantage.

i. **Domestic mining**. China brought its domestic mining activities under focussed control in the 20th century to scale up production at low unit cost but high socio-environmental impact. Flooding the global market with low-cost raw materials effectively made rival mines subeconomic. With the closure of international mines, a monopoly of production of multiple critical minerals ensued.

ii. **Domestic integration**. Reducing dependence on external markets reduces the negative impacts of global commodity price fluctuations. Balancing internal and external circulation means that resources can be funnelled preferentially into domestic supply chains and protect downstream

[4] https://www.chathamhouse.org/2020/08/debunking-myth-debt-trap-diplomacy
[5] Zoogah BD, Mthuri JN, Moore KR, Rapanyane MB (eds). Chinese Engagement in Africa's Mining Sector: The Consequences of Minimal Investment. Anticipated publication by Palgrave MacMillan in 2026.

manufacturing. Chinese companies are adopting models of vertical integration to include mining, processing, manufacturing and reprocessing (e.g. Ganfeng Lithium company).

iii. **Risk-proofing domestic raw materials flows**. It is a cost- and time-intensive activity to restart mines anywhere, yet there are operational, social, environmental and climate risks (flooding has cause operations to cease at Chinese mines). The '*Mineral Resources and Emergency Response*' clause (stockpiling and emergency mining in reserve areas) of the Chinese mining law will ensure that the Chinese raw material pipeline is uninterrupted without spiralling commodity price, making it difficult for other nations to re-enter markets using former mines, even where they hold extensive mineral reserves.

iv. **Securing international supplies**. Expansion of the flows of raw materials from international jurisdictions into Chinese processing and refining sectors works on the efficiencies of scale and ensures that China has monopolies on supply chains for critical mineral that it does not mine within nation. Working within national regulation in foreign jurisdictions, which that are more lax than costly Chinese best practice, maintains the flow of cheap raw material so that the addition of mineral value occurs within China.

v. **Knowledge partnership and transfer**. There are multiple ways in which China has benefitted from innovation transfer and integration. International collaboration with the Soviet Union after the Communist Revolution helped to build Chinese dominance in critical mineral processing technologies. Technology transfer has been used more recently as a vehicle for partnering with nations that are rich in raw materials. Advanced technological competency has been maintained and extended by an immensely powerful top-tier academic research landscape that drives industrial growth, and that engages in academic partnering.

vi. **Protection of strategic supply chains and intellectual property**. Collaboration for innovation is tempered by protection of strategic intellectual property, counter-tariffs and/or control of exports. Products are often marketed on the basis of performance rather than design elements and there is opacity about supply chains for particular energy- and defence-related applications. China responds strongly to economic or military threats using its dominance in critical minerals supply.

4 What is the likelihood that China will use dependencies against the UK and what will its impact be?

Beijing uses export controls as leverage in challenging international negotiations. The export controls are applied more widely to critical minerals than to intermediate (e.g. semiconductors) technologies. The UK will be impacted by any global trade wars for critical minerals that it does not mine and process within nation, and where subsequent (intermediate) manufacturing is not based in the UK. The UK Critical Minerals Intelligence Centre is producing industry-specific foresight reports to understand how the IS8 sectors of the UK Industrial Strategy would be impacted by commodity shortages.

The ways in which global export controls impact the UK are manifold but, so far, they are largely driven by relations that other countries have with China. China has warned that hyping the China threat and overstretching security concepts could lead to tightening of export controls on critical

minerals to the UK and other western nations. Precedent has been set. The UK is at risk for several reasons, largely as a function of UK relations with third countries, with some key points briefly outlined below.

i. The UK has strong alignment with some US strategies[6], e.g. on export of semiconductor technology to China (this has eased recently in the US). The US rhetoric about China weaponizing critical minerals stems from the central, aggressive role that the U.S. Department of War plays in managing critical minerals, driven by a national security mandate to secure supply chains for defence systems and diminish foreign reliance. In response to the tariffs imposed by the Trump administration, China has enacted new export controls. Some key milestones are:

2018-2019	Trump first administration applied tariffs to increasing numbers of imports from China. A trade war escalated with China immediately retaliating.
2020-2025	The '*Phase One*' trade agreement on Chinese purchasing of US goods was not realised due to the economic effects of the Covid-19 Pandemic. The trade deal nevertheless persisted through the Biden Administration (2021-2025).
2025	Trump second administration applied larger tariffs that solicited swift response. The effects were slowed global trade, increased uncertainty and raised costs. However, the US aim of reducing reciprocal imports was realised. China introduced extra* licences for export of: tungsten, tellurium, bismuth, indium, molybdenum, heavy REE.
2026	US Supreme Court: US tariffs inconsistent with international trade rules. US Court of international Trade: US should issue refunds and repayments of $160 billion dollars.

* Some commodities were already under export control as a measure to safeguard Chinese national security and interests, for example gallium and germanium (since 2023)[7].

ii. International leverage using critical minerals supply is not restricted to trade negotiations. The most well-known actual and potential supply shocks relates to sovereignty disputes between China and Japan, and China and Taiwan. The three countries have complex historical sovereignty relations. China dominates raw materials production. Taiwan manufactures over 60% of the world's semiconductors and more than 90% of the most advanced chips[8] . Japan is a dominant, top-tier global force in car manufacturing, in competition with China. Any global withholding of raw materials in order to leverage relations in East Asia has implications for UK. An example is the REE crisis of 2010, which forced nations to try to diversify their supply chains, reduce reliance on China and increase research into alternative materials and recycling:

[6] https://www.theguardian.com/politics/2025/may/14/china-issues-warning-to-uk-over-terms-of-us-trade-deal
[7] https://www.iea.org/policies/17893-announcement-on-the-implementation-of-export-control-of-items-related-to-gallium-and-germanium
[8] https://www.trade.gov/country-commercial-guides/taiwan-semiconductors-including-chip-design-ai

2010	Japan arrested a Chinese fishing boat captain after a collision with Japanese Coast Guard vessels near disputed islands. China put export restrictions of up to 40% on tungsten, molybdenum and REE. Japanese automotive and electronics manufacturing initially affected.
2010-2012	Actual and perceived shortages caused REO commodity prices to skyrocket. Investment in exploration surged. More than $4 billion investment was raised for REE exploration by junior exploration companies as a response.
2015	World Trade Organisation (WTO) ruled export restrictions broke international trade laws. China was forced to reform its policies or face potential trade sanctions from the US, EU and Japan.

There have been multiple WTO rulings against export restrictions by China, which China has variably complied with or developed strategies to bypass (e.g. the Dual Circulation Strategy).

iii. The critical minerals agenda is tied to military strategy in complex ways. The US supply of arms to Taiwan, which is viewed as a breakaway province by the Chinese administration[9], creates tension. The US is in conflict with Iran, a major trading partner and oil supplier to China. China is cautious in its support for Iran in the current conflict[10] even though Beijing and Tehran signed a "comprehensive strategic partnership agreement" in 2021 covering economic, security, and technological cooperation over a 25-year period. Nevertheless, China understandably appears reticent about supplying raw materials for military applications to the US since that will ultimately harm its regional sovereign and global economic ambitions. The commodities (for example: gallium, germanium, antimony and tungsten) that are restricted by Chinese export controls are those with dual-use in civil and military applications.

iv. Iron is a critical mineral of both UK and China. China's Ministry of Commerce acted to protect the interests of a major Chinese manufacturing company by urging the UK (14th May 2026) to act cautiously in its decisions regarding plans to nationalize British Steel[11]. This followed actions by the Chinese company Jingye Group to wind down its UK operations. Consequently, the UK sought to maintain domestic steel-making capacity and avoid repeating the errors of the latter 20th century when the UK lost ground to international trade, in the foundation industries in the upstream end of supply chains. The bilateral UK-China relations in this case are unaffected by third countries and administrations have stated diplomacy to find mutually beneficial solutions.

6. What lessons can we learn about international responses to critical minerals risks and opportunities, and how can they help us work with other countries?

The critical minerals strategies of multiple countries are broadly similar to that of the UK: increasing domestic supply; diversification of supply chains; extending the circular economy. The

[9] https://www.independent.co.uk/asia/east-asia/taiwan-china-independence-rump-xi-jinping-b2976388.html
[10] https://www.uscc.gov/research/china-iran-fact-sheet-short-primer-relationship
[11] https://www.gov.uk/government/news/new-legislation-gives-government-power-to-bring-british-steel-into-public-ownership

UK has just a few key critical mineral resources that are economically competitive on the global mining stage: tin, tungsten, lithium. Foreign actors (particularly US) are interested in investing in UK mining operations. A mix of investment partners is not unusual for mining operations. But care needs to be taken to secure 'internal circulation' for UK manufacturing.

The investment power of other nations is a function of their critical minerals budget. Some key examples of strategic and nationally-funded initiatives are below, with investment converted approximately to UK STLG.

US	£36 billion to support Defence Production Act purchases, energy innovation, and the industrial sustainment program. 'Project Vault' is the strategic stockpile initiative.
Australia	£12 billion towards green energy and critical minerals. 10% tax incentive for processing and refining.
Japan	£5.3 billion in public and private funding to support the critical minerals strategy, with a particular focus on circular economy and innovation. £27 billion in joint US-Japan energy and critical mineral projects.
EU	€3 billion plan under the RESourceEU action plan to boost its critical minerals sector, speed up strategic projects, and reduce dependencies on single-country suppliers. Regulatory development to reduce approval times (from 10-15 years to less than 3 years, CRM Act).
Canada	£2.56 billion for Critical Minerals Sovereign Fund, Critical Mineral Infrastructure Fund, First and Last Mile Funds. 30% Critical Mineral Exploration Tax Credit.
Nigeria	£548 million for solid minerals exploration. Mandate that >30% or ore is processed locally.
Chile	£103 million for mineral exploration and investment pipeline, policy management and community engagement.
Namibia	Ban on unprocessed critical mineral export since 2023 to ensure that value addition occurs domestically.
R. South Africa	Focus on private sector investment in rail and port bottlenecks to ensure reliable export.

There is a significant movement towards stockpiling initiatives that ensure stability for the holding country. However, release of stockpiles can flood markets to control supply chains and crash prices so there is an inherent risk for production other jurisdictions, such as the UK.

The UK has a stated budget of £50 million (Vision 2035: Critical Minerals Strategy) to boost domestic production, accelerate research and development (R&D), and support commercialization of critical minerals. This is not competitive with other countries that have larger economies (US, collective EU), comparable economies (Japan) and smaller economies (Australia, Canada, Nigeria, Chile). Despite the smaller budget, UK has a lot to offer in terms of critical minerals knowledge economies and sustainable production.

The UK innovates in processing technologies but does not have processing capacity. Since this is only likely to develop for a very small set of commodities (some battery metals and tin, tungsten),

vertically integrated and collaborative supply chains will require UK partnering with countries other than China. Key considerations are where will sufficient feedstock be located for optimal siting of alternative processing and refining hubs, and whether sufficient foreign direct investment will be forthcoming to establish viable processing routes that do not flow through China. For the UK, diplomacy and investment will establish reliable and secure supply chains from international partners to strategic industrial sectors.

G7 and G20 will be hosted by UK in 2027. Key conversations for diversified supply chains might focus on the nexus of best practice, green financing, more equitable distributions of wealth and capability development, specifically as it relates to breaking the upstream bottlenecks:

i. What investment instruments can be developed to promote local processing capabilities, which benefit regional and national retention of mineral wealth?
ii. What is the knowledge needed to support international agreements that logistically and equitably optimise alternative processing supply chains?
iii. How do we ensure that inequality in current investment power does not result in new critical mineral dependencies and risks that replicate past issues of criticality, i.e. geographical bottleneck in alternative supply chains?
iv. How is innovation fostered globally by collaboration in industrial and academic research, so that it does not reinforce concentration of bottlenecks in the supply chains?
v. Can risk be mitigated for international mining regions/communities as well as mitigating risk for mining companies, by translating ESG for investors into real terms sustainability?
vi. How can high domestic standards for responsible mining be applied in foreign jurisdictions, i.e. beyond the national requirements, to safeguard operations?
vii. Can an international socio-environmental cost of mining be established, to be paid equally in all jurisdictions, and how would this have the potential to reshape supply chains?