SYM-AM-25-329

Excerpt from the Proceedings

of the

Twenty-Second Annual Acquisition Research Symposium and Innovation Summit

Wednesday, May 7, 2025 Sessions
Volume I

Competing at the Upstream of Innovation: The US-China Balance in Critical Minerals

Published: May 5, 2025

The research presented in this report was supported by the Acquisition Research Program at the Naval Postgraduate School.

To request defense acquisition research, to become a research sponsor, or to print additional copies of reports, please contact any of the staff listed on the Acquisition Research Program website (www.acquisitionresearch.net).

Acquisition Research Program
Department of Defense Management
Naval Postgraduate School

Competing at the Upstream of Innovation: The US-China Balance in Critical Minerals

Nathan Picarsic—is a senior fellow at the Foundation for the Defense of Democracies, a senior visiting fellow at the Krach Institute for Tech Diplomacy, and a co-founder of Horizon Advisory. [nate.picarsic@post.harvard.edu]

Emily de La Bruyère—is a senior fellow at the Foundation for the Defense of Democracies, a senior visiting fellow at the Krach Institute for Tech Diplomacy, a non-resident fellow at the National Bureau of Asian Research, and a co-founder of Horizon Advisory. [ebde@alumni.princeton.edu]

Abstract

The United States and China are in the throes of a long-term, peacetime competition. That contest has, thus far, centered on science, technology, and industry. The means deployed have been non-kinetic: export controls, investment restrictions, market protections, and trade remedies. Critical and strategic materials – the upstream of legacy and emerging technological applications – have figured prominently in these peacetime salvos. China and the United States have very different capabilities in critical and strategic minerals. They also have very different approaches to the domain. This paper provides an overview of the asymmetries in strategic orientation defining the critical mineral postures of the US and China; the threats that those asymmetries pose to the United States; and the role that the defense acquisition system can play in facing down those threats.

China has an upper hand in critical and strategic minerals. Beijing has proven its willingness to use that upper hand offensively. And China is investing, disproportionately – vis-à-vis its broader science and technology program – in early-stage innovation in minerals and materials that could lock in the PRC's advantage and disrupt American downstream strengths. This reality poses a direct national security and economic security threat to the United States. Beijing's market control, pricing power, and distortive effects are such that extant market forces cannot resolve the threat within the current economic order. Despite the severity of this strategic challenge, the defense acquisition system can strengthen US defenses, support and direct early-stage research and development to enhance US strengths, and, ultimately, position to impose costs on China-tied supply chains.

Introduction

China treats supply chains – and, especially, the upstream of supply chains – as the core elements of geopolitical competition in today's globalized world. And Beijing considers its current positioning in critical supply chains to be a core asset in its arsenal for confronting the United States; a trump card vis-à-vis America's leadership in cutting-edge technologies.

Chinese government discourse is explicit about the country's supply chain strategy. The Chinese Ministry of Transport has stated that, "enterprise competition is no longer a competition among individual companies, but rather among supply chains." Xi Jinping himself explained in in 2016 that:

> If a company is heavily dependent on foreign countries for its core components, and if the 'major artery' of the supply chain is in the hands of others, it is like building a house on someone else's foundation. No matter how big and beautiful it is, it may not stand up to wind and rain, and it may be so vulnerable that it collapses at the first blow. (Xi Jinping, 2016)

The Chinese government – in both its discourse and its resource allocations – is also explicit about prioritizing critical and strategic minerals as it competes for supply chains. This prioritization encompasses access to strategic minerals, industrialization of them, and leapfrog innovation in both the materials science used to produce them and their applications. In order to enhance its power, Beijing wants independence in these materials and the geopolitical leverage that comes from the dependence of the rest of the world.

As early as 1986, the State Council published the Mineral Resources Law of the People's Republic of China, declaring that “the development, utilization and protection of mineral resources should adhere to the leadership of the Communist Party of China” to “implement the overall national security concept.” Over the decades since, Beijing has secured strongholds in global mineral supply. Beijing has also invested in cutting-edge research and development in strategic minerals intended to cement next-generation leadership in the field, and foster leapfrog capabilities in their applications. And China has shown willingness to use its strategic mineral capabilities for coercive ends. In 2010, amid a territorial dispute with Tokyo over the Senkaku Islands, Beijing temporarily ceased exports of select, critical rare-earth elements to Japan. (Keith Bradsher, 2010)

Both China’s prioritization of strategic minerals and its framing of them as offensive assets have only increased in recent years. In November 2024, the 12th Meeting of the Standing Committee of the 14th National People’s Congress adopted a new version of the Mineral Resources Law, to come into effect in July 2025. The new Mineral Resources Law makes clear that strategic minerals are inputs into national security: “Mineral resources are an important material basis for economic and social development, and the exploration and development of mineral resources are related to the national economy, people's livelihood and national security.”

And the actions that Beijing has taken in parallel with drafting and issuing the Mineral Resources Law make clear that as inputs into national security, strategic minerals are offensive as well as defensive assets. Since 2024, in response to US tariffs and technology restrictions, China has implemented its own export controls on critical minerals including gallium, germanium, and antimony as well, more recently, as restrictions on various rare earth elements. (Amy Lu, 2025)

Beijing’s ability and willingness to implement these export controls reflects an asymmetry vis-à-vis the United States. America has begun to recognize the importance of secure, independent supply chains, and of critical minerals in those, in its competition with China. But this recognition lags that of the PRC. And Beijing’s multi-decade advance -- as well as its centralized state system, industrial capacity, and natural resource advantages -- have allowed China to secure a clear upper hand in the strategic minerals contest. Moreover, the United States tends to focus on critical minerals as an area in which to play defense; to protect against Chinese dominance. Beijing by contrast uses strategic minerals for offensive ends.

This dynamic creates obvious threats for the United States. Beijing has leverage, over minerals critical for both security and commercial applications. The Chinese government has refined mechanisms for using that leverage for coercive effect. And China is investing in early-stage breakthroughs that could both lock in China’s upstream advantage and disrupt America’s downstream strength. Moreover, Beijing is adept at leveraging its pricing power, technological advantage, and full value-chain approach in critical minerals to undermine emergent US efforts to establish truly independent, domestic supply chains. China’s broad-based dominance grants Beijing varying degrees of veto power over American efforts to unleash market forces to solve for its current weaknesses.

And considering both the security relevance of the threat at hand and the impossibility of relying on China-distorted markets to face it down, defense acquisition processes and actors have important roles to play countering China’s critical minerals threat. Those roles should include doubling down on defense, as for example with stockpiling of critical minerals. They should also include investments in early-stage research and development. And the defense acquisition system can incorporate upstream vulnerabilities into program requirements and performance metrics to shift market incentives away from China.

The Critical Minerals Landscape: A US Disadvantage

Both Washington and Beijing have promulgated policies defining, respectively, “critical” and “strategic” minerals. In 2016, China’s Ministry of Land and Resources published the National Mineral Resources Plan. (Ministry of Land and Resources, 2016) That document presented a list of 24 strategic minerals, including energy, metallic, and non-metallic minerals. (Though the list also groups all “rare earth” together as one. Because there are 17 rare earth minerals, Beijing might more accurately be described as having identified 40 strategic minerals.)

A year later, pursuant to “Executive Order 13817A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals,” the US began to publish lists of “critical minerals.” The most recent such list, published in 2022, covered 50 minerals. (US Geological Survey, 2022)

If rare earth minerals are counted individually, 27 of the minerals on the US list of critical minerals also appear on China’s of strategic minerals, as reflected in the table below, while 23 are unique to the US list. And 12 of China’s “critical minerals” are captured in the US list. One obvious and notable discrepancy lies in China’s inclusion of “energy minerals” – or oil, natural gas, shale gas, coal, coal bed methane, and uranium – under strategic minerals, while the United States only captures metallic and non-metallic minerals.

Strategic and Critical Minerals, as Defined by China and the US[1]		
China: Strategic Minerals		**US: Critical Minerals**
Energy minerals	Oil, natural gas, shale gas, coal, coal bed methane, uranium	**Aluminum, antimony,** arsenic, barite, beryllium, bismuth, **cerium,*** cesium, **chromium, cobalt**, **dysprosium**,* **erbium**,* **europium**,* **fluorspar**, **gadolinium**,* gallium, germanium, **graphite**, hafnium, **holmium**,* indium, iridium, **lanthanum**,* **lithium**, **lutetium**,* magnesium, manganese, **neodymium**,* **nickel**, niobium, palladium, platinum, **praseodymium**,* rhodium, rubidium, ruthenium, **samarium**,* **scandium**,* tantalum, tellurium, **terbium**,* **thulium**,* **tin**, titanium, **tungsten**, vanadium, **ytterbium**,* **yttrium**,* zinc, and **zirconium.**
Metallic minerals	Iron, **chromium**, copper, **aluminium**, gold, **nickel**, **tungsten**, **tin**, molybdenum, **antimony**, **cobalt**, **lithium**, **rare earths**, **zirconium**	
Non-metallic minerals	Phosphorus, potash, **crystalline graphite**, **fluorspar**	

No matter the set of strategic or critical minerals adopted, China is clearly better positioned in terms of both access to the minerals themselves and production through midstream processing. The United States is more than 50 percent import dependent in 38 of the minerals that it has identified as critical. In five of the remaining 12 cases, there is insufficient data to assess US import dependence. The US is also 45 percent import dependent in copper and 93 percent in potash, both of which China defines as “strategic minerals,” though the US does not. And in 30 of its 50 critical minerals – including 25 of the 38 in which it is more than 50 percent import dependent – the US relies on China as one of its critical suppliers. By contrast, according to available figures, chromium is the only strategic mineral for which China is essentially completely reliant on foreign imports. (US Geological Survey, 2024).

[1] Bolded words are minerals that are listed as strategic or critical by both countries. Rare earths are marked with an asterisk.

US Import Dependence and Sources in Prioritized “Critical Minerals”			
Prioritized by	**Mineral**	**US Import Dependence (%)**	**Major US import sources (2020-2023)**
China/US	**Aluminum**	47	Canada, UAE, Bahrain, China
China/US	**Antimony**	85	China, Belgium, India, Bolivia
China/US	**Cerium**	80	China, Malaysia, Japan, Estonia
China/US	**Chromium**	77	South Africa, Kazakhstan, Canada, Finland
China/US	**Cobalt**	76	Norway, Finland, Japan, Canada
China/US	**Dysprosium**	80	China, Malaysia, Japan, Estonia
China/US	**Erbium**	80	China, Malaysia, Japan, Estonia
China/US	**Europium**	80	China, Malaysia, Japan, Estonia
China/US	**Fluorspar**	100	Mexico, Vietnam, South Africa, China
China/US	**Gadolinium**	80	China, Malaysia, Japan, Estonia
China/US	**Graphite**	100	China, Canada, Mexico, Mozambique
China/US	**Holmium**	80	China, Malaysia, Japan, Estonia
China/US	**Lanthanum**	80	China, Malaysia, Japan, Estonia
China/US	**Lithium**	>50	Chile, Argentina
China/US	**Lutetium**	80	China, Malaysia, Japan, Estonia
China/US	**Neodymium**	80	China, Malaysia, Japan, Estonia
China/US	**Nickel**	48	Canada, Norway, Australia, Brazil
China/US	**Praseodymium**	80	China, Malaysia, Japan, Estonia
China/US	**Samarium**	80	China, Malaysia, Japan, Estonia
China/US	**Scandium**	100	Japan, China, Philippines
China/US	**Terbium**	80	China, Malaysia, Japan, Estonia
China/US	**Thulium**	80	China, Malaysia, Japan, Estonia
China/US	**Tin**	73	Peru, Bolivia, Indonesia, Brazil
China/US	**Tungsten**	>50	China, Germany, Bolivia, Vietnam
China/US	**Ytterbium**	80	China, Malaysia, Japan, Estonia
China/US	**Yttrium**	100	China, Germany
China/US	**Zirconium.**	<25	South Africa, Australia, Senegal
US only	**Arsenic**	100	China, Morocco, Malaysia, Belgium
US only	**Barite**	>75	India, China, Morocco, Mexico
US only	**Beryllium**	0	
US only	**Bismuth**	89	China, Republic of Korea
US only	**Cesium**	100	Germany, China
US only	**Gallium**	100	Japan, China, Germany, Canada

US only	**Germanium**	>50	Belgium, Canada, China, Germany
US only	**Hafnium**	NK	Germany, China
US only	**Indium**	100	Korea, Japan, Canada, Belgium
US only	**Iridium**	NK	
US only	**Magnesium**	>75	Israel, Canada, Turkey, Czechia
US only	**Manganese**	100	Gabon, South Africa, Australia, Malaysia
US only	**Niobium**	100	Brazil, Canada
US only	**Palladium**	36	Russia, South Africa, Belgium, Italy
US only	**Platinum**	85	South Africa, Belgium, Germany, Italy
US only	**Rhodium**	NK	
US only	**Rubidium**	NK	
US only	**Ruthenium**	NK	
US only	**Tantalum**	100	China, Australia, Germany, Indonesia
US only	**Tellurium**	<25	Canada, Philippines, Japan, Germany
US only	**Titanium**	86	South Africa, Madagascar, Canada, Australia
US only	**Vanadium**	40	Canada, Brazil, Austria, South Africa
US only	**Zinc**	73	Canada, Mexico, Republic of Korea, Peru

A Difference in Strategic Orientation: Offense vs. Defense

Perhaps more important than the specific minerals identified by the US and China – and even relative dependencies in them – is the difference in the two sides' strategic orientations toward strategic and critical minerals. Washington approaches the field with a defensive posture. United States policy defines "critical minerals" as those with supply chains vulnerable to disruption; the United States invests to enhance its access to critical minerals but not to limit that of China, or other adversaries; and in its technological strategy, the United States de-prioritizes investment in research, development, and innovation related to minerals and materials.

Beijing's approach is the opposite. China's orientation toward strategic minerals is an offensive one. China's definition of "strategic minerals" includes both those that are weaknesses and those that are strengths. China has shown a capacity and political will to wields its mineral advantages for coercive effect. And China prioritizes investments in the cutting-edge of mineral and material research and development – in order to establish enduring leadership over the field.

The Definitional Divide

China's 2016 National Mineral Resources Plan defined strategic minerals based on their value to industry and to national security: They are the minerals necessary to "safeguard national economic security, national defense security and the development needs of strategic emerging industries."

The 2017 "Executive Order 13817A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals presented a contrasting US framework for identifying critical minerals. Like the Chinese definition, that framework hinges on importance to national security and industry. But it also hinges on vulnerability. Critical minerals, per the United States, are those that are "(1) are "essential to the economic and national security of the United States," (2) have supply chains that are "vulnerable to disruption," and (3) serve "an essential function in the manufacturing of a product, the absence of which would have significant consequences for our economy or our national security."

Those policy definitions, published at almost the same time by the US and China, align on the value that critical or strategic minerals provide; these are necessary inputs for both security and industry. But the definitions differ in their relative emphases on vulnerability. For a mineral to be included in the US framing of critical minerals, it must be vulnerable to supply chain disruption. It must be a defensive concern. That is not the case for China. Beijing includes in its definition not only minerals on which it depends on international players, but also those in which it dominates the global market or has offensive capabilities. The Chinese approach centers more fully for the objective importance of a given material – and leaves room to prioritize those minerals that Beijing can use to coerce.

That PRC orientation is not limited to the National Mineral Resources Plan. Researchers at the Institute of Mineral Resources under the Chinese Academy of Geological Sciences argued in a 2021 paper published in Acta Geoscientica Sinica, a journal associated with the China Geological Survey, that the criteria for judging the strategic value of a mineral should include not only its economic significance and import dependence, but also whether it has "international market advantages and certain bargaining power and have important uses in strategic emerging industries."

That difference between the US and Chinese orientations toward strategic and critical minerals is borne out in the lists of specific minerals identified by the two countries. Of the critical minerals on the US list, there is only one, beryllium, in which America is a net exporter. By contrast, Beijing includes rare earths in its set of strategic minerals, despite the country's' dominance in the field: China accounts for 60 and 87 percent, respectively, of global rare earth production and processing.

Contrasting Postures

The asymmetry in orientation is not simply rhetorical. It has also concretely informed the manner in which the two countries have wielded their relative mineral positioning. US activities in critical and strategic minerals have tended to be purely defensive – and largely reactive at that. Washington has focused on investing to shore up weaknesses and dependencies vis-à-vis China. And even in those areas where the United States *does* have an upper hand in critical mineral value chains, the country has at no point leveraged, or threatened to leverage, that advantage. For instance, even as America has begun to treat China as an adversary, and even as Washington has imposed export controls and trade barriers on Beijing, there has at no point been any threat to limit the export of beryllium, a critical input into aerospace, nuclear, and medical fields – and for which China depends on imports from the United States. (World Bank, 2025)

Beijing, on the other hand, has consistently, over the past quarter century, leveraged its supply chain advantages for offensive effect – and not just against the United States. As early as 2010, amid a territorial dispute with Tokyo over the Senkaku Islands, Beijing temporarily ceased exports of select, critical rare-earth elements to Japan. In hindsight, that move was an early clue as to how Beijing would wield influence globally. Over recent years, as tensions between China and the United States have escalated, Beijing has again and again retaliated against Washington by limiting the export of critical materials. In 2024, after the United States placed restrictions on the export of advanced semiconductor technology to China, China responded by imposing export restrictions on gallium, germanium, and antimony to the United

States. All three are critical inputs into semiconductors – and US-defined critical minerals – in which China holds a globally dominant position. And in 2025, after President Trump placed a new round of tariffs on imports from China, Beijing retaliated by implementing export controls on a host of minerals and mineral products, including samarium, gadolinium, terbium, dysprosium, lutetium, scandium, and yttrium, as well as their alloys and oxides.

Back in 2010, when restricting rare earth exports to Japan, China did so surreptitiously. Beijing denied at the time that it was leveraging international trade – and its positioning at the upstream of strategic value chains – for coercive, geopolitical effect. Today, Beijing is explicit about its activities. Beijing frames export controls of critical minerals very clearly as retaliation; Beijing describes its advantage in them as a trump card in evolving security and industrial competition.

Asymmetric Investment Patterns

The difference in the two sides' strategic orientation toward critical minerals is further borne out in how they invest in the field – and, especially, in relevant research and development (R&D). Broadly speaking, across tech areas generally, the United States tends to prioritize early stage R&D and corresponding innovation far more than does China. Beijing instead emphasizes refinement, application, and scaling of proven technologies. Government budget figures bear out this difference. In 2024, less than seven percent of China's R&D spending went to basic research. For the US, that figure is some three times as high: The US FY2023 budget allocated 23 percent of R&D dollars to basic research. (Ministry of Commerce, 2024)

But in critical and strategic minerals, and upstream materials more generally, the relative prioritization of basic research and development flips. The United States eschews basic R&D in the field. There is very little emphasis – in either US technology or US mineral policy – on upstream-relevant research and development. Instead, discussion of and policy in the field focuses on identification of, development of capacity in, and development of processing capabilities for resources known to be valuable for contemporary use cases. The same holds for investment. For instance, Department of Defense research, development, test, and evaluation (RDT&E) funding goes to component development and downstream complete systems, not to upstream inputs even in fields of investment focused on the earliest stage of basic science. (Congressional Research Service, 2022)

Beijing's investments follow a very different pattern. China, disproportionately vis-à-vis the rest of its technology program, invests in early-stage innovation in minerals and materials, with the stated ambition of capturing the leading heights in and shaping the direction of the field, as well as its downstream applications. This prioritization is spelled out in the 14th Five Year Plan for National Economic and Social Development – the guiding, central document detailing Beijing's ambitions and plans for the 2021 to 2035 period. That plan explicitly lists "basic materials" as a "key and core technology to prioritize," and "new materials" as a "pillar of the industrial system." It also asserts that China will focus on technological breakthrough in the field:

> We will promote breakthroughs in advanced metals and inorganic non-metallic materials such as high-end rare earth functional materials, high-quality special steels, high-performance alloys, high-temperature alloys, high-purity rare metal materials, high-performance ceramics, and electronic gases; we will strengthen the research and development and application of carbon fiber, aramid fiber, and other high-performance fibers and their composite materials and bio-based biomedical materials; and we will accelerate breakthroughs in key technologies of high-performance resins, such as metallocene polyethylene, and high-purity electronic materials such as photoresists for integrated circuits.

Resource allocations bear out this framing. More than 30 of China's National Key Laboratories focus specifically on metals and/or materials. And their work covers basic research and development. The National Key Laboratory of Rare Metal Special Materials, for instance, pursues "original theoretical and subversive application technology research," in order to "make technical breakthroughs in stuck neck targets" and "creat[e] a leading position in China and even in the world." The National Key Laboratory of New Technologies for Intensified Metallurgy of Nonferrous Metals funds both theoretical and applied work, including research on the "theory of efficient enrichment and enhanced separation of complex copper, lead, and zinc resources;" "basic research on solid waste resource utilization and urban mine development;" and "basic research on clean and low-carbon extraction and metallurgical technology of refractory copper resources using microorganisms." The National Key Laboratory of Research and Comprehensive Utilization of Bayan Obo Rare Earth Resources offers another case. That laboratory's mandate leans toward applied research and development. It is intended to focus on research, development, and utilization of existing rare earth resources in the Bayan Obo Region. But it pursues that work with an emphasis on developing new breakthroughs, for example in "new technologies for mining and smelting." (Innovation China, 2025)

In other words, while Beijing is generally content to be a fast follower in the global tech and industrial competition, China is investing to be not only a powerhouse but also a first mover in minerals and materials. Beijing is working to develop breakthroughs in the materials sciences that promise "leapfrog" or "overtaking" in downstream domains.

Conclusion: Implications of the Competitive Balance

The upstream of critical materials has become a new battleground in the race for technological supremacy. The United States and China both recognize the utility of critical materials for today's geopolitical and national security competitions. US INDO-PACOM Commander ADM Sam Paparo put a fine point on it in recent remarks about the risk of kinetic conflict with China: "You can't AI your way out of material deficiency." (John Grady, 2025)

Supply and sustainment of critical materials matters for the weapons systems and defense posture of today. It also matters for developing the determinative capabilities of tomorrow – those that carry security as well as commercial importance. And the US is at risk of losing out to China across the board.

China has developed an advantage in critical minerals and shown its willingness to use that advantage to coerce. At a first order and in the immediate, this means that China can create real battle damage in the exchange of peacetime salvos – like, for example, with export restrictions on gallium and germanium. And Beijing's threat is positioned only to grow in the future. Unlike most realms of technological competition, China eschews its typical "fast follower" approach to seizing advantage at the upstream. Critical materials constitute one outlier realm in which Beijing invests to generate breakthroughs. And that effort threatens to allow Beijing not only to wield advantage in critical materials for coercive effect today, but also to lock in such advantage for tomorrow and, ultimately, use it to unseat downstream US leadership. Meanwhile, the United States has largely remained in reactive and defensive modes as it attempts to catch up with Beijing's upstream lead.

China critical mineral positioning poses a next order threat as well. Beijing has positioned to stymy US efforts to defend, let alone to compete. Beijing is adept at leveraging its pricing power, technological advantage, and full value-chain approach in critical minerals to undermine US efforts to establish truly independent, domestic supply chains. China can, for instance, hold at risk access to equipment necessary for mineral processing. Or – bigger picture and more troubling – China can, right as the US develops nascent critical minerals capabilities, flood global markets to tank global prices, therefore pricing fledgling US players right out of the game.

This competitive balance, or imbalance, is such that the US needs to take immediate and drastic action. And considering both the security relevance of the threat at hand and the impossibility of relying on China-distorted markets to face it down, defense acquisition processes and actors have important roles to play in that action.

The US approach to the upstream of innovation needs to see a doubling down of defense. For example, the US should work to develop stockpiles of critical minerals – to include relevant processed oxides and alloys – to meet defense industrial base demand that China may otherwise place at risk. Those efforts will require coordination across policy, acquisition, and industrial base actors that each have roles to play in bolstering US and allied supply chains. Private stockpiles, refining and processing operations, and mines all, for example, could benefit from explicit offtake signals from defense acquisition programs coordinated through Defense Production Act or other relevant acquisition authorities.

At the same time, the US needs to move beyond the defensive. The US needs to take an offensive tack, and one that does not simply react to China's positioning and signaled or latent leverage. That offensive should include promotion of mineral- and material-relevant research and development, focused both on finding alternatives to China dependence and on enhancing US strengths. The US defense acquisition ecosystem has enormous potential for increasing early stage, basic research activities and directing those activities toward materials sciences domains that may propel critical mineral breakthroughs, all along the value chain from extraction to midstream processing to applications.

In addition, where possible, the US defense acquisition system can chip away at China's market and pricing power by imposing more costs on China-tied supply chains. US downstream manufacturers, including the defense industrial base, can serve as catalysts in the effort to develop independent supply lines by committing to upstream procurements from domestic sources. Acquisition processes can reinforce the incentives for such downstream alignment by incorporating upstream vulnerabilities into program requirements and performance metrics.

Reference List

Bradsher, Keith, "China is Said to Resume Shipping Rare Earth Minerals," *The New York Times*, October 28, 2010.

de La Bruyère, Emily and Nathan Picarsic, "Understanding How China Secured Its Chip Stack, "Hinrich Foundation, April 2025,https://www.hinrichfoundation.com/research/wp/tech/understanding-how-china-securedits-chip-stack/.

de La Bruyère, Emily and Nathan Picarsic, *Elemental Strategy: Countering the Chinese Communist Party's Efforts to Dominate the Rare Earth Industry*, Foundation for Defense of Democracies, February 2022, https://www.fdd.org/analysis/2022/02/10/elementalstrategy-countering-the-chinese-communist-partys-efforts-to-dominate-the-rare-earthindustry/.

de La Bruyère, Emily and Nathan Picarsic, "Two Markets, Two Resources: Documenting China's Engagement in Africa," US-China Economic and Security Review Commission, November 2020, https://www.uscc.gov/sites/default/files/202011/Two_Markets_Two_Resources_Documenting_Chinas_Engagement_in_Africa.pdf.

Doshi, Rush, Emily de La Bruyère, John Ferguson, and Nathan Picarsic, “China as a ‘cyber great power’: Beijing’s two voices in telecommunications,” Brookings Institution, April2021, https://www.brookings.edu/articles/china-as-a-cyber-great-power-beijings-twovoices-in-telecommunications/.

Grady, John, “INDOPACOM CO Paparo Outlines Risk of Western Pacific Conflict,” USNI, April10, 2025, https://news.usni.org/2025/04/10/indopacom-co-paparo-outlines-risk-ofwestern-pacific-conflict.

Jinping, Xi, “□□□□□□□□□□□□□□□□□□□[The Full Text of Xi Jinping’s Speech at the Forum on Cybersecurity and Informatization Work],” Xinhua, 2016.

Lu, Amy and Tony Munroe, "China Bans Export of Critical Minerals to US as Trade Tensions Escalate," Reuters, December 3, 2024.

Puko, Timothy, “U.S. Is Vulnerable to China’s Dominance in Rare Earths, Report Finds,” *Wall Street Journal*, June 29, 2020, https://www.wsj.com/articles/u-s-is-vulnerable-to-chinasdominance-in-rare-earths-report-finds-11593423003.

“2022 Final List of Critical Minerals,” US Geological Survey, February 2022.https://www.federalregister.gov/documents/2022/02/24/2022-04027/2022-final-list-of-critical-minerals.

“Department of Defense Research, Development, Test, and Evaluation (RDT&E): Appropriations Structure,” Congressional Research Service, September 2022,https://sgp.fas.org/crs/natsec/R44711.pdf.

“Executive Order 13817A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals,” December 20, 2017.

“Federal Research and Development (R&D) Funding: FY2024,” US Congress, April 10, 2025.

“The Role of Critical Minerals in Clean Energy Transitions,” International Energy Agency, May 2021.

"Outline of the PRC’s 14th Five Year Plan for National Economic and Social Development [□□□□□□□□□□□□□□□□□□□□□□□2035□□□□□□□]," March 13,2021.

US Geological Survey, “Mineral Commodities Summary,” 2024.

World Bank World Integrated Trade Solution, Accessed 2025.

"Zhengzhou University and CNMC (Ningxia) Dongfang Group Co., Ltd. Held a Signing Ceremony for the Joint Construction of the 'National Key Laboratory of Rare Metal Special Materials' [□□□□□□□□□□□□□□□□□□□□□□“□□□□□□□□□□□□□□”□□□□]", Zhongyuan Critical Metals Laboratory, March 8, 2023.

"□□□□□□□□□□□□□□□□□□□□□□ [Bayan Obo Rare Earth Resources Research and Comprehensive Utilization National Key Laboratory]," Innovation China, March 12, 2025.

"□□□□□□□□□□□□□□□□□□□□□□□□□□(2024□□) [Application Guide for Open Topics of the National Key Laboratory of New Technologies for Intensified Metallurgy of Nonferrous Metals (2024)]," Chinalco, May 21, 2024.

"□□□□□□□□□□R&D□□□□□□□□□ [China's Research and Development (R&D) Funding Has Grown Steadily]," National Bureau of Statics, January 23, 2025.

"□□□ □□□□□□ 2025□□ 18□ □□□□□□□□□□□□□□□□□□□□□[Ministry of Commerce and General Administration of Customs Announcement No. 18 of 2025 Decision on Implementing Export Control on Some Medium and Heavy RareEarth-Related Items]," China Ministry of Commerce, April 4, 2024.

"国内外战略性矿产厘定理论与方法 [Theory and Methods of Strategic Mineral Determination at Home and Abroad], Acta Geoscientia Sinica, 2021(2).

"□□□□□□□□□2016—2020□□National Mineral Resources Plan (2016-2020)]," Ministry of Land and Resources, 2016.

"□□□□□□□□□2016—2020□□National Mineral Resources Plan (2016-2020)]," Ministry of Land and Resources, 2016.