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Congressional Testimony of Dr. Morgan D. Bazilian, Professor and Director, Payne Institute for Public Policy at Colorado School of Mines

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Chairman Stauber, Ranking Member Ansari, and Members of the Subcommittee, it is an honor to appear before you today on the important topic of critical minerals and national security.

My name is Morgan Bazilian, and I am a Professor and Director of the Payne Institute for Public Policy at the Colorado School of Mines. The Institute distills and translates cutting-edge scientific and engineering research into insights for decisionmakers globally. I have spent the bulk of my career in public service across three decades and several continents – most recently as lead energy specialist at the World Bank focused on addressing energy poverty. I am one of the world's leading scholars on the topics being discussed at today's Hearing.

The Colorado School of Mines has an extraordinary depth of knowledge on these topics, with expertise ranging from mining and metallurgy, to economics, policy, anthropology, and chemistry. While I cannot adequately reflect the entirety of that portfolio in this testimony, I will emphasize that this area, like most, requires both humility and a truly interdisciplinary approach—technocratic perspectives alone will prove myopic.

IMPETUS

Let me begin by saying that I believe strongly that the United States should urgently and effectively ramp up our domestic mining and refining operations in a manner that utilizes best practices for environment and community engagement, employs sophisticated financial tools, and puts our nation in a strong position on global supply chains. This is in the economic and security interests of the country and will also support American workers and companies.

There are positive developments from Arkansas, to Nebraska, to Nevada that can become world-class mining assets. However, in designing approaches that move us to greater economic and security benefits one should be aware that the value add to an economy is much greater through the production of advanced technologies than ores. Additionally, the various supply chains are complex, dynamic, and deeply intertwined with the wider economy.

The United States possess a wealth of these minerals – in the Earth's crust, on the ocean floor, and possibly in space. They are also available as co-products and recycling. That said, we largely ceded our leadership in this sector many decades ago to China. Catching up is unlikely to be a productive policy goal, as China is hardly standing still. They are, in fact, investing billions all over the world, and are more effective at building large infrastructure than our system will (or should) allow. *AidData* reported last week that between 2000-2021, Chinese Banks and their partners issued $57 billion in loans to low- and middle-income countries for producing and processing several critical minerals.

The primary impetus for this hearing and related discussions stems from the Chinese dominance of the sector – and I am using that term not as rhetorical flourish, but one based on empirics. In the late twentieth century, China emerged as a formidable global power and the predominant mineral producer worldwide. According to the US Geological Survey, the most noteworthy transformation in global mineral production from 1990 to 2018 was the exponential increase in China's mineral output. By 2022, China had assumed the top position in the production of 30 out of the 50 minerals listed as critical by the US. This reliance exposes the United States to supply chain disruptions, such as the export ban that China imposed on antimony, gallium, and germanium to the United States last year.

Last year, we correctly noted that "Moving forward, China could impose export controls on other minerals – like bismuth, rubidium, and tantalum." And further, "China could expand its export bans to include other minerals on its dual-use export control list. These minerals include the following: aluminum, beryllium, bismuth, calcium, graphite, hafnium, magnesium, nickel (powder), rhenium, titanium, tungsten, zinc, and zirconium." Much of this has now been signaled by China.

Minerals are necessary for American national defense, economic prosperity, and energy security. Rare earth elements are used in Virginia-class attack submarines, and copper is used in 155 mm artillery shells. Platinum group metals are used in catalytic converters, while gallium is used in advanced semiconductors. Tungsten is used in exploration drill bits, and copper is used in transmission lines. In short, minerals are foundational across the modern economy and becoming more so. In a positive development last week, *MP Materials* commenced commercial production of neodymium-praseodymium metal and trial production of automotive-grade, sintered neodymium-iron-boron magnets in Texas.

These so-called critical minerals—the once forgotten elements crucial to modern day technology—have made it to the top of the geopolitical agenda. They have become a common refrain and part of the accepted lexicon in government and industry alike. While this attention remains, it is worth trying to fundamentally shift the perception of an industry that has suffered a poor reputation for millennia. Still, these issues largely remain quotidian to much of the population.

My comments will focus on the national security implications, as opposed to the more typically elucidated energy demands for these materials. That said, I have written and researched these

sometimes disparate topics in some depth and have provided links to several of these pieces in the References.

HISTORY

This is not a new topic – especially as it relates to security and warfighting.

Historians, geologists, and government officials have long acknowledged the nexus between a state's mineral resources and its economic and military power. In 1902, historian Brooks Adams asserted that, "all experience has demonstrated that the centre of mineral production is likely, also, to be the seat of empire. In 1916, US Secretary of the Interior Franklin K. Lane prioritized minerals as the foremost "foundations of power," a sentiment echoed by US Geological Survey Director George Otis Smith, who affirmed "that mineral wealth is the foundation of power." In 1939, geologist C. K. Leith highlighted, "Military power used to be measured principally by manpower, but is coming more and more to be measured in terms of guns, ships, automobiles, and airplanes, and the fuel to drive them. These mean minerals."

The Defense Production Act, which was modeled after the War Powers Acts of 1941 and 1942, allows the federal government to begin prioritizing national defense over private-sector needs. The current version of the law allows the president, through executive order, to allocate "materials, services, and facilities" for national defense purposes and to offer loans or guarantees to private companies. During the 1950s, President Truman used the act to regulate the steel and mining industries, ensuring the U.S. military could procure adequate wartime supplies. As the Cold War escalated, the Truman administration employed the DPA to boost the supply of manganese, a mineral critical for steel production and one that was put under an embargo by the Soviet Union. Truman also invoked the DPA to establish domestic aluminum and titanium industries through the provision of capital and interest-free loans.

During the first decade of the Cold War, the US government stockpiled enough minerals to cover a five-year conflict with the Soviet Union. By 1962 this meant a reserve worth over $77 billion adjusted for current prices. This stockpile was housed at over two hundred locations, ranging from military depots to commercial warehouses, and it contained large-volume minerals like aluminum, copper, lead, and acid-grade fluorspar—some of the most commonly used minerals by the Department of Defense. Today, the existing National Defense Stockpile is insufficient for supporting the US military in a major conflict. The stockpile targets enough inventories for just a one-year conflict with China, followed by a three-year recovery. Even so, the present reserve—which is worth only $912.3 million and stored at just six locations—meets less than half of the military's estimated demand in this scenario. It also lacks any inventories of critical aluminum, copper, lead, and acid-grade fluorspar.

To reduce the risks of mineral disruptions, the US government—across multiple administrations—has taken various actions. In his first term, President Trump signed Executive Order 13817, which

directed the Federal Government to publish a list of critical minerals and a federal minerals strategy.

President Biden continued and expanded the efforts of the first Trump Administration. Backed by significant appropriations from Congress, the Department of Energy committed billions of dollars in loans to mineral processing projects, and the Department of Defense awarded hundreds of millions of dollars in grants for mineral projects in both the United States and Canada. The State Department also established the Minerals Security Partnership – following the development of a diplomatic effort under the first Trump Administration known as the Energy and Resource Governance Initiative.

It is worth recalling that American jobs—in Pennsylvania, Kentucky, West Virginia, Michigan, Indiana and across our industrial heartland—depend on Canadian critical minerals. Nickel in particular, a critical mineral essential for military and defense applications. America has only one nickel mine in the entire country, and it is slated to close within the next 10 years. We have no nickel refinery, so everything we mine we send to Canada and then buy back. For more than 70 years this has been a stable, reliable, affordable relationship with our most significant ally and trading partner. Canada supplies roughly 50% of the nickel used in our military and more than 80% of the nickel used in our aerospace sector. Uranium is another strategic mineral consideration for trade with our northern partners—and not an insignificant one for either energy or security needs. Likewise, Canadian potash is essential for our agricultural sector and food security.

We certainly need to develop our own mines and refineries – but working with allies will be indispensable to success in creating robust, secure, and resilient supply chains.

While international financing is important, investing in developing and emerging countries carries significant risk. That has been evident in the default of US backed loans (from DFC and DOE) for a graphite project in Mozambique due to civil unrest in that country. The graphite was destined for processing in Louisiana. It remains important to look for such opportunities, but the groundwork and diligence required takes time and sharp analysis. Related, initiatives like *The Copper Mark* that bring improved transparency to supply chains will expand in relevance—they also can bring competitive advantage for the United States as we produce these materials under strict regulations.

Finally, as a reminder, this is not an issue only being addressed by the United States. Many countries have critical minerals lists—in some cases with fundamentally different motivations. Our country has at least three such unclassified lists. The DOD's efforts are perhaps the most sophisticated, as they consider not just minerals, but processed materials—they also consider future demand scenarios and not just a snapshot of the present. Improving the sophistication of these methodologies, while seemingly prosaic, would help improve decision making. To that end, various parts of the intelligence and defense community are undertaking regular tabletop exercises looking at different vectors of these issues. Those games will help inform how we can plan for, and react to, the myriad risks to national security.

ACTION

Last November, colleagues and I outlined several considerations for furthering the vital role of critical minerals and materials in supporting US national security.

President Trump has already issued several Executive Orders that involved critical minerals, including the “Unleashing American Energy”. While previous federal actions on minerals largely sought to increase financial support for mineral projects, the President’s new EO directs other actions too, such as tariff investigations and permitting actions.

Most notably, the EO directs the Council on Environmental Quality to rescind its implementing regulations for the National Environmental Policy Act (NEPA) and instead issue guidance for agencies to implement NEPA regulations. This action could represent the most serious change to NEPA since its inception depending on what agency-level regulations are eventually adopted. Additionally, the next Trump administration could permit more mines on federal lands. For example, the Biden administration banned mining in Minnesota’s Boundary Waters Canoe Area Wilderness and surrounding watershed for twenty years—that decision may be reversed.

Another key domestic project is the Resolution Copper project in Arizona. I had the opportunity to visit Resolution last year, and travel several thousand feet down their mine shaft. It is located in the footprint of an existing mine, in an area called the “Copper Triangle” of Arizona where mining has been a fabric of the rural economy for more than 100 years. The deposit is planned be mined using underground methods and has the potential to produce up to 25% of US demand for copper, as well as a host of critical mineral co-products. In addition, the managing company produces final refined copper and critical minerals from one of two operating smelters and refineries left in the U.S. This is down from about 20 such operations existed a few decades ago. For a sense of scale, China operates over 50 copper smelters and refineries.

Adopting demand-side policies that support US mineral projects – crucial for making financing work is essential for getting to financial investment decisions. On the upstream side, rebuilding America into a mineral powerhouse faces a financial pitfall on the verge of production: mineral projects often struggle to secure funding for turning a mineral discovery into an operational mine. The reasons are various, including the large upfront capital investment and long payback time, as well as permitting risks and price volatility. The United States needs a bridge over this somewhat unique “valley of death” in the mineral project lifecycle.

Mineral projects have a long phase of development that entails rigorous state and federal permitting processes, regular community engagement, environmental studies, cultural surveys and consultation with tribal sovereign governments. Once a ‘feasibility study’ is completed to assess a project’s viability, mining companies seek to secure permits and financing before they can begin construction.

This phase takes time and money and has an unpredictable timeline. Based on an analysis of 270 active mines, the average duration from a completed feasibility study to mine operation is three

years, with 10 percent of projects taking over six years to begin operations. This time frame includes permitting, economic assessment, and construction. Due to permitting or financing challenges, many mining projects with completed feasibility studies do not reach the operational stage. For 450 non-operational projects, it has been an average of seven years since the feasibility study was conducted, with 10 percent of projects taking longer than 11 years. This is where our critical minerals ambitions get stuck: between exploration and construction, unable to secure the financing needed for permitting, engineering, and environmental reviews. It is telling that only three mines have come online in the US over the last two decades, none of which were on federal lands, with roughly 10 projects stuck in development.

The markets for this diverse set of minerals and chemicals are often small, illiquid, have poor transparency and even worse price discovery. Lithium carbonate's price (according to the excellent Benchmark Minerals Intelligence team) rocketing from $8,500/tonne in December 2020 to $81,000/tonne in December 2022 and now back down to about $14,500/tonne, underlines the aggressive nature of how these inflexible markets can flip. It also makes investment decisions exceedingly difficult. The case of Jervois' Idaho cobalt project is instructive here. The once only active cobalt mine in the country halted construction because of falling cobalt prices.

Strengthening U.S. mineral supply chains is an important area of bipartisan agreement. Thus, this 119th Congress offers a significant opportunity for substantive action on critical minerals. Several areas stand out.

Congress could pass legislation increasing funds for mineral stockpiling, including for minerals used heavily in conflict but presently absent from the U.S. stockpile, such as copper. Mineral stockpiling already receives bipartisan support in Congress, as evidenced by pending FY 25 legislation to allocate $600 million to the National Defense Stockpile Transaction Fund. Congress could also explore expanding the purpose of the National Defense Stockpile from "national defense only" to include economic security, such as stockpiling minerals from domestic mineral producers at above-market prices amid price slumps. China already uses its own stockpiles this way, allowing it to exert a powerful influence on market prices. As I noted, the frailty of current markets makes it even easier for China to exert this control.

Congress could fund more educational and research programs, too, including grants for recruiting and educating mineral-focused students—as the bipartisan Mining Schools Act, advanced last Congress by this committee, would provide. Mining and geological engineers are expected to have modest employment growth of 2 percent from 2023 to 2033, but more than half of the current U.S. mining workforce is expected to retire by 2029, leaving a workforce gap. And the workforce pipeline is bottlenecked: The number of mining-related graduates has dropped 39 percent since 2016. Today, there are 14 mining engineering programs in the U.S.—down from 25 in 1982. Last year, these mining schools collectively enrolled 590 undergraduate students, graduating just 162 students for an industry demand of 400-600 new mining engineers each year. In comparison, China's 45 mining engineering programs currently enroll about 12,000 students and graduate

approximately 3,000 a year—about 18.5 times the number of graduates in the United States. Increased R&D investments in next generation mining technologies for identifying, mining, recycling, and processing minerals and to reclaim, remediate, and reuse existing mines would be an important complement to this training.

Congress could pass legislation seeking to streamline the permitting process for mineral projects. Specifically, the legislation could modify the litigation process for mineral projects. A team at the Institute for Progress recommended establishing a time limit for injunctive relief—that is, a court order preventing construction—for projects subject to review under the National Environmental Policy Act. The time limit would begin with the initiation of the NEPA review and end shortly after the conclusion of the NEPA review.

Another area for improved legislation is enhancing the industry's supply chain reporting in government procurement, especially by the Defense Department. In previous years, the National Defense Authorization Act has included reporting requirements on the provenance of minerals in permanent magnets. These reporting requirements could be expanded to other defense goods, such as munitions and platforms like naval vessels.

Lastly, institutions are part of the solution set as well. Congress could pass legislation reviving the Bureau of Mines or creating a similar entity, such as a proposed National Critical Minerals Council. Established in 1910, the Bureau of Mines initially worked on addressing mine health and safety issues, eventually expanding into information gathering on the domestic and global mineral industries as well as research on mining and processing technology. As its functions were largely absorbed by other federal agencies over time, the bureau was dissolved in 1996 amid budgetary battles in Congress.

All of these actions could be included in the development and implementation of a national critical mineral strategy.

LAND

My final comment is on a topic often overlooked in these proceedings. That is: critical minerals security and success in the United States is intimately tied to Indian Country.

Native American Tribes stand to benefit greatly from mining and processing the critical minerals needed to drive the energy transition in the United States — but only if we acknowledge the sordid history of mining on Tribal lands and properly remediate legacy issues while forging a new approach that is transparent, fair, and centered on Tribal sovereignty and creating vibrant economies.

Mining offers Tribes a major opportunity. Tribal lands hold roughly 50% of US uranium reserves. And, approximately 97% of U.S. nickel reserves, 89% of its copper reserves and 79% of its lithium reserves lie on or within 35 miles of Native American reservations (MSCI). Tribes could also

benefit from choosing to become better networked and integrated into domestic and global supply chains. To wit, a deal was inked last week allowing the US company Energy Fuels Ltd. to transit uranium across the Navajo Nation, and also engage in the cleanup of abandoned mines.

If the federal government respects Tribal sovereignty, resource extraction and related projects such as natural gas development, power plants, and data centers on Tribal lands can help create economic prosperity.

Thank you very much for the privilege of speaking in this august chamber today.

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