Statement of Dr. Nedal T. Nassar
Section Chief, National Minerals Information Center
U.S. Geological Survey
before the
U.S. Senate Committee on Energy and Natural Resources
on
June 24, 2020

Good morning Chairman Murkowski, Ranking Member Manchin, and Members of the Committee, and thank you for the opportunity to discuss the U.S. Geological Survey's efforts related to mineral supply chains.

Background

The Department of the Interior manages one-fifth of the Nation's lands, as well as the Nation's offshore energy. These responsibilities include leasing and permitting activities for both onshore and offshore access to and development of the Nation's mineral resources, through the Bureau of Land Management (BLM) and the Bureau of Ocean Energy Management (BOEM). The U.S. Geological Survey (USGS) Mineral Resources Program (MRP) conducts scientific research on how mineral resources form geologically, provides earth-science based assessments on the geologic potential for mineral commodity occurrences across the Nation and globe, and studies the life cycle of those resources with a focus on their origin and characteristics; supply, demand, and trade; and characteristics of mineral wastes.

Within MRP, the National Minerals Information Center collects the Nation's data on domestic and international supply and demand for over 90 minerals and mineral materials essential to the economy and national security. These data support analyses on the flow of resources through the global economy as both commodity and waste. These data also provide the essential foundation for understanding and quantifying mineral supply risk and support the development of the U.S. Critical Minerals List and the Federal Critical Minerals Strategy.

Statement

Mineral commodities are the foundation of modern society. Smartphones would have more dropped calls and shorter battery lives without tantalum capacitors and cobalt-based cathodes in lithium-ion batteries. Bridges, buildings, and pipelines would not be as strong without vanadium and other alloying elements in steels. Medical MRI machines would use more energy and produce lower-quality images without helium-cooled niobium-based superconducting magnets. Jet engines would operate at lower temperatures and be less efficient without rhenium in their turbine blades.

While the drive towards smaller, faster, lighter, and smarter technologies will increase demand for these and other commodities whose properties are uniquely suited for the task,[1] the stability of their supply is not necessarily assured.

Among other things, the COVID-19 pandemic highlights the fragility of global supply chains and underscores the risks of supply disruptions during a crisis. This is only the most recent reminder of such risks to economies that are heavily reliant on imported goods and materials, with global supply chains having recently endured disruptions stemming from trade wars, labor strikes,[2] natural disasters,[3,4] and previous disease outbreak.[5] China's threats to cut-off rare earth supplies in 2010 epitomized these risks for importing countries who had limited alternatives due to China's near-monopoly of the rare earth supply chain.

The concentration of production is not, however, limited to rare earths. The mining and mineral processing of many raw materials that underpin manufacturing supply chains have become increasingly concentrated—a decades-long trend. The tantalum and cobalt in smartphones, for example, are now predominately mined in the Democratic Republic of the Congo and refined in China. Having such concentrated production increases the potential for supply disruptions.

Concurrently, developed countries such as the United States have become increasingly import reliant for their mineral commodity needs,[6,7] thereby increasing their exposure to foreign supply disruptions.

In our latest research, we examined the risk of mineral commodity supply disruptions to the U.S. manufacturing sector by assessing the likelihood of and exposure and vulnerability to foreign supply disruptions.[8] The study assessed over 50 commodities and identifies a subset including cobalt, graphite, niobium, tantalum, and the rare earths as having the greatest supply risk.

Predictably, China is the largest producer of most high-supply risk commodities. For commodities which China does not have sufficient domestic resources, such as cobalt and niobium,[9] Chinese firms have sought to secure supplies through foreign investments in mineral assets worldwide.[10]

Notably, many high-supply risk commodities are recovered as byproducts, such as cobalt. The supply of byproducts has the additional challenge of potentially being unresponsive to demand signals given their relatively minimal contribution to producers' revenues.[11]

This research is thus an enhancement to the original methodology[12] used to develop the U.S. Critical Minerals List and forms the basis for updating the List through the interagency process established under the U.S. National Science and Technology Council's Critical Minerals Subcommittee.

Once a mineral supply chain is identified as high-risk, the next step is to determine the best way to reduce the risk. Various strategies can be pursued including diversification of supply, identification and potential expansion of domestic mineral resources, increasing recycling, developing substitutes, maintaining strategic inventories, and bolstering trade relationships. In response to Executive Order 13817 and through the interagency process, the U.S. Department of Commerce released a Federal strategy entitled, "*A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals*", on behalf of the U.S. National Science and Technology Council, in which these and other actions are explicitly outlined.[13]

Importantly, many of these strategies are core to missions of many federal agencies. The U.S. Defense Logistics Agency, for example, is responsible for maintaining strategic and critical materials in the U.S. National Defense Stockpile thereby providing a measure of resilience in the event of a disruption. Over the past seven years, the U.S. Department of Energy's Critical Materials Institute has been researching and developing alternative materials and enhanced recycling techniques. In coordination with the Association of American State Geologists, the USGS launched the Earth Mapping Resources Initiative to improve the geological, geophysical, and topographic mapping of the United States and thus advance our understanding of the potential geological resources of our country.[14] The strategy released by the U.S. Department of Commerce also recognizes the potential to reprocess mine wastes for resources, an issue spanning multiple agencies.

At USGS, we continue to improve our capability to analyze mineral supply chains and assess the associated supply risk through advanced modeling techniques that will soon allow us to quantify how different supply disruptions may ripple through and impact the economy. We are also expanding our capability to develop forward-looking supply and demand scenarios that will help anticipate how certain trends and disruptive technologies, such as vehicle electrification, may impact the minerals industry.

Each commodity supply chain is unique. Moreover, bottlenecks may occur at different stages of the supply chain. For example, while there is now substantial rare earth mine production outside of China, bottlenecks in downstream processing and magnet manufacturing remain. Each mineral supply chain must therefore be examined individually to determine the most effective strategy needed at each stage with the ultimate goal of minimizing the overall risk to the U.S. economy and national security so that we, as a Nation, are better prepared for when another devastating event like the COVID-19 pandemic strikes.

Thank you for the opportunity to testify and I look forward to any questions you may have.

References

(1) Graedel, T. E.; Harper, E. M.; Nassar, N. T.; Reck, B. K. On the Materials Basis of Modern Society. *Proc. Natl. Acad. Sci. U. S. A.* 2015, *112*, 6295–6300. https://doi.org/10.1073/pnas.1312752110.

(2) Yager, T. R.; Soto-Viruet, Y.; Barry, J. J. *Recent Strikes in South Africa's Platinum Group Metal Mines: Effects upon World Platinum Group Metals Supplies. Open-File Report 2012–1273*; U.S. Geological Survey: Reston, VA, 2013. https://doi.org/10.3133/ofr20121273.

(3) Menzie, W. D.; Baker, M. S.; Bleiwas, D. I.; Kuo, C. *Mines and Mineral Processing Facilities in the Vicinity of the March 11, 2011, Earthquake in Northern Honshu, Japan*; U.S. Geological Survey: Reston, VA, USA, 2011. https://pubs.usgs.gov/of/2011/1069/.

(4) Schnebele, E.; Jaiswal, K.; Luco, N.; Nassar, N. T. Natural Hazards and Mineral Commodity Supply: Quantifying Risk of Earthquake Disruption to South American Copper Supply. *Resour. Policy* 2019, *63*, 101430. https://doi.org/10.1016/j.resourpol.2019.101430.

(5) Bermúdez-Lugo, O.; Menzie, W. D. *The Ebola Virus Disease Outbreak and the Mineral Sectors of Guinea, Liberia, and Sierra Leone*; U.S. Geological Survey: Reston, VA, USA, 2015. https://doi.org/10.3133/fs20153033.

(6) Fortier, S. M.; DeYoung, J.H., Jr.; Sangine, E.; Schnebele, E. K. *Comparison of U.S. Net Import Reliance for Nonfuel Mineral Commodities—A 60-Year Retrospective (1954–1984–2014)*; U.S. Geological Survey: Reston, VA, USA, 2015. https://doi.org/10.3133/fs20153082.

(7) U.S. Geological Survey. *Mineral Commodity Summaries 2020*; U.S. Geological Survey: Reston, VA, USA, 2020. https://doi.org/10.3133/mcs2020.

(8) Nassar, N. T.; Brainard, J.; Gulley, A.; Manley, R.; Matos, G.; Lederer, G.; Bird, L. R.; Pineault, D.; Alonso, E.; Gambogi, J.; Fortier, S. M. Evaluating the Mineral Commodity Supply Risk of the U.S. Manufacturing Sector. *Sci. Adv.* 2020, *6* (8), eaay8647. https://doi.org/10.1126/sciadv.aay8647.

(9) Gulley, A. L.; Nassar, N. T.; Xun, S. China, the United States, and Competition for Resources That Enable Emerging Technologies. *Proc. Natl. Acad. Sci.* 2018. https://doi.org/https://doi.org/10.1073/pnas.1717152115.

(10) Gulley, A. L.; McCullough, E. A.; Shedd, K. B. China's Domestic and Foreign Influence in the Global Cobalt Supply Chain. *Resour. Policy* 2019, *62*, 317–323. https://doi.org/10.1016/j.resourpol.2019.03.015.

(11) Nassar, N. T.; Graedel, T. E.; Harper, E. M. By-Product Metals Are Technologically Essential but Have Problematic Supply. *Sci. Adv.* 2015, *1* (3), e1400180. https://doi.org/10.1126/sciadv.1400180.

(12) Fortier, S. M.; Nassar, N. T.; Lederer, G. W.; Brainard, J.; Gambogi, J.; McCullough, E. A. *Draft Critical Mineral List—Summary of Methodology and Background Information—*

U.S. Geological Survey Technical Input Document in Response to Secretarial Order No. 3359; Reston, VA, 2018. https://doi.org/10.3133/ofr20181021.

(13) U.S. Department of Commerce. *A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals*; U.S. Department of Commerce: Washington, D.C., 2019. https://www.commerce.gov/sites/default/files/2020-01/Critical_Minerals_Strategy_Final.pdf.

(14) Warren, D. C. *The Earth Mapping Resources Initiative (Earth MRI)—Mapping the Nation's Critical Mineral Resources*; U.S. Geological Survey: Reston, VA, USA, 2019. https://doi.org/10.3133/fs20193007.