Statement of Dr. Nedal T. Nassar
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U.S. Geological Survey
before the
House Committee on Natural Resources
Subcommittee on Energy and Mineral Resources
on
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Good morning, Chairman Stauber, Ranking Member Ocasio-Cortez, and Members of the Subcommittee. Thank you for the opportunity to discuss the U.S. Geological Survey's critical minerals work. My name is Nedal T. Nassar and I am the Chief of Minerals Intelligence Research at the U.S. Geological Survey (USGS).

Background

The USGS is the science arm of the Department of the Interior and brings impartial, actionable science to an array of stakeholders and partners, including decision-makers like yourselves, resource managers, and the public.

Congress passed the USGS's Organic Act in 1879, in part to gain greater understanding of our Nation's mineral resources. That remains central to our mission 144 years later, although our tools have changed, and today our science serves a wider range of objectives. For example, through the Earth Mapping Resources Initiative (Earth MRI) and our growing national mine-waste inventory, we are mapping the potential for mineral occurrence with advanced instruments that are deployed in space, in the air, in the laboratory, and on the ground, all leading to a better understanding of our country's mineral resources both in the ground and in waste streams. And through our mineral supply chain analyses, we advise other federal agencies on supply chain risks and investments in their sectors of expertise.

The United States remains a major mineral producer, and in 2022, the domestic mineral industry mined $98.2 billion worth of mineral commodities.[1] However, over the past half-century, mineral supply chains have become more complex as both new and established technologies rely on an increasing volume and variety of minerals. Most future energy-sector technologies are mineral-intensive, and therefore also potentially land-intensive and water-intensive; neither domestic production nor trade eliminates these challenges. Other economic sectors' mineral demands are also increasing. The U.S. economy is demanding traditional mining products like iron, aluminum, copper, sand, gravel, and cement. We also see rising demand for nontraditional mineral commodities that are required for new technologies essential to our national and economic security. While the USGS addresses all of these mineral commodities, a set of essential mineral commodities for which there are significant supply chain risks are designated as critical minerals, and they are at the center of the USGS' minerals-related research.

[1] U.S. Geological Survey, 2023, Mineral commodity summaries 2023: U.S. Geological Survey, 210 p., https://doi.org/10.3133/mcs2023.

List of Critical Minerals and Changes to the List

The USGS provides the Nation's data and statistics on domestic and global production and consumption of minerals. Under the Energy Act of 2020, the USGS regularly analyzes those data to develop a whole-of-government list of critical minerals based on global mineral supply chains across all economic sectors. This cross-sectoral approach is coordinated across the Federal Government through the National Science and Technology Council's Critical Minerals Subcommittee (NSTC CMS), which is co-chaired by the White House Office of Science and Technology Policy, the U.S. Department of Energy, and the USGS. The initial methodology and list, published in 2018[2] under the direction of Executive Order 13817, was updated in 2021 in response to the Energy Act of 2020,[3] reviewed by other Federal agencies through the NSTC CMS and by the public, and a final list of 50 critical mineral commodities was published in the Federal Register on February 24, 2022.[4]

In developing the list of critical minerals, we apply data on the Nation's production and consumption of mineral commodities, all provided voluntarily by industry, to evaluate supply risk. When sufficient data to support quantitative analysis are not available, we analyze supply risk qualitatively, for example by identifying supply chains that include a single point of failure. Table 1 shows the 2022 list of critical minerals and their rationale for inclusion. Table 1 also highlights that many mineral commodities on the list are recovered as byproducts from mining and processing of other, non-critical mineral commodities.

Figure 1 lists the commodities for which supply risk was evaluated using quantitative tools, including how the supply risk for each has changed over time; it also shows the countries that are the major producers of each of those commodities. The 2022 list of critical minerals identifies gallium as having the greatest U.S. supply risk, a risk that has become a reality as a result of the recent export controls imposed by the People's Republic of China on gallium and germanium.

Over time, we expect the list of critical minerals to evolve. The Energy Act of 2020 requires that the list be updated at least once every three years. As supply chains are strengthened for minerals currently on the list, or if specific minerals become less important to the U.S. economy or national security, those minerals may come off the list. Similarly, minerals may be added to future lists if their supply becomes less secure or the U.S. economy becomes more dependent on applications for which those minerals are primary inputs.

The methodology for developing the list will evolve as we and our interagency partners gather additional data and develop better tools to anticipate and quantify supply and demand disruptions.

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[2] Fortier, S.M., Nassar, N.T., Lederer, G.W., Brainard, J., Gambogi, J., and McCullough, E.A., 2018, Draft critical mineral list—Summary of methodology and background information—U.S. Geological Survey technical input document in response to Secretarial Order No. 3359: U.S. Geological Survey Open-File Report 2018–1021, 15 p., https://doi.org/10.3133/ofr20181021.

[3] Nassar, N.T., and Fortier, S.M., 2021, Methodology and technical input for the 2021 review and revision of the U.S. Critical Minerals List: U.S. Geological Survey Open-File Report 2021–1045, 31 p., https://doi.org/10.3133/ofr20211045.

[4] 2022 Final List of Critical Minerals https://www.federalregister.gov/documents/2022/02/24/2022-04027/2022-final-list-of-critical-minerals.

Recent Federal Investments Guided by USGS Analysis

Since we released the most recent list of critical minerals, the list and its underlying analysis have informed some of the Nation's largest investments in mineral supply chains. These investments include recent Defense Production Act investments and Bipartisan Infrastructure Law (BIL) critical minerals provisions focused on multiple supply chain stages. USGS data and analyses are informing partner agencies' decision-making for a number of these investments. Within the USGS, we are accelerating Earth MRI mapping of areas with potential to contain critical minerals and investing in the preservation of historical data and samples related to critical minerals. Under the Energy Act of 2020, the USGS also uses the list of critical minerals to help prioritize mineral resource assessments. The USGS is focusing its next series of resource assessments on critical minerals needed for high-capacity batteries and grid-energy storage applications before assessing other critical minerals (Figure 2).

Scenario Analysis and Forecasting

The USGS monitors supply chains across sectors, which allows us to understand cumulative supply risks. For example, we examine cross-sectoral competition for materials needed for energy, consumer electronics, and construction. We provide mineral supply chain data and analyses to a variety of Federal decision-makers, including the Defense Logistics Agency's stockpile managers, the National Security Council, the State Department, the Department of Commerce, the U.S. Trade Representative, and the Intelligence Community.

Over the past several years, our data have provided evidence of supply chain disruptions in mineral production and shipping attributable to the COVID-19 pandemic as well as evidence of recovery. Mineral supply chains have also seen disruptions associated with natural disasters and with export restrictions imposed by trading partners. We continuously monitor the effects of such disruptions across the suite of minerals we track.

The Energy Act of 2020 calls for the USGS to further develop its forecasting capability. Accordingly, the USGS has expanded the range of official statistics reported annually in the Mineral Commodity Summaries and is developing a new series of five-year global mineral outlooks. The President's 2024 budget request proposes to further increase the speed of USGS critical mineral supply chain forecasting and its responsiveness to current events.

This focus on supply chain analysis and forecasting supports whole-of-government efforts to strengthen supply chains. The USGS works to provide strong scientific evidence on the feasibility and impacts of domestic primary and secondary (recycling and reprocessing of waste) production and on the potential to secure supplies through trade with reliable partners. Under the BIL, the NSTC CMS is authorized to coordinate investments in science and technology to support these strategies. In support of these efforts, the USGS identifies potential future critical minerals and evaluates whether these investments are in fact strengthening supply chains.

Summary

In summary, the USGS provides cross-sectoral, data-driven supply chain analyses that inform whole-of-government efforts to strengthen supply chains. The list of critical minerals is one tool to inform investments in supply chains. The list and its underlying analyses also provide a rich set of data and tools that can be used to better understand the specific risks potentially affecting individual technologies, industries, or commodities originating from a particular geographic area or trading partner; to identify key trade relationships that may need strengthening; and to target investments in alternative sources of supplies for economically vital products. The USGS has deep expertise in near- and long-term mineral supplies, supply risk, and the potential for supply shocks. By partnering with other agencies that specialize in sector-specific demand forecasting and the potential for demand shocks associated with the emergence and growth of specific technologies, we can provide an even richer picture of the future risks to mineral supply chains. This information can help policymakers target interventions that will increase the security of our Nation's minerals supply.

Thank you for the opportunity to testify today. I look forward to your questions.

Highest to lowest supply chain risk, based on quantitative evaluation [5]	Mineral commodity	Included on the 2022 list of critical minerals?	Basis for recommended inclusion	On 2018 list of critical minerals?	Predominantly recovered as byproduct? [6]
1	Gallium	Yes	Quantitative evaluation	Yes	Yes.
2	Niobium	Yes	Quantitative evaluation	Yes	No.
3	Cobalt	Yes	Quantitative evaluation	Yes	Yes.
4	Neodymium	Yes	Quantitative evaluation	Yes	Yes.
5	Ruthenium	Yes	Quantitative evaluation	Yes	Yes.
6	Rhodium	Yes	Quantitative evaluation	Yes	Yes.
7	Dysprosium	Yes	Quantitative evaluation	Yes	Yes.
8	Aluminum	Yes	Quantitative evaluation	Yes	No.
9	Fluorspar	Yes	Quantitative evaluation	Yes	No.
10	Platinum	Yes	Quantitative evaluation	Yes	No.
11	Iridium	Yes	Quantitative evaluation	Yes	Yes.
12	Praseodymium	Yes	Quantitative evaluation	Yes	Yes.
13	Cerium	Yes	Quantitative evaluation	Yes	Yes.
14	Lanthanum	Yes	Quantitative evaluation	Yes	Yes.
15	Bismuth	Yes	Quantitative evaluation	Yes	Yes.
16	Yttrium	Yes	Quantitative evaluation	Yes	Yes.
17	Antimony	Yes	Quantitative evaluation	Yes	Yes.
18	Tantalum	Yes	Quantitative evaluation	Yes	No.
19	Hafnium	Yes	Quantitative evaluation	Yes	Yes.
20	Tungsten	Yes	Quantitative evaluation	Yes	No.
21	Vanadium	Yes	Quantitative evaluation	Yes	Yes.
22	Tin	Yes	Quantitative evaluation	Yes	No.
23	Magnesium	Yes	Quantitative evaluation	Yes	No.
24	Germanium	Yes	Quantitative evaluation	Yes	Yes.
25	Palladium	Yes	Quantitative evaluation	Yes	Yes.
26	Titanium	Yes	Quantitative evaluation	Yes	No.
27	Zinc	Yes	Quantitative evaluation	No	No.
28	Graphite	Yes	Quantitative evaluation	Yes	No.
29	Chromium	Yes	Quantitative evaluation	Yes	No.
30	Arsenic	Yes	Quantitative evaluation	Yes	Yes.
31	Barite	Yes	Quantitative evaluation	Yes	No.
32	Indium	Yes	Quantitative evaluation	Yes	Yes.
33	Samarium	Yes	Quantitative evaluation	Yes	Yes.
34	Manganese	Yes	Quantitative evaluation	Yes	No.
35	Lithium	Yes	Quantitative evaluation	Yes	No.
36	Tellurium	Yes	Quantitative evaluation	Yes	Yes.
37	Lead	No	Not applicable	No	No.
38	Potash	No	Not applicable	Yes	No.
39	Strontium	No	Not applicable	Yes	No.
40	Rhenium	No	Not applicable	Yes	Yes.
41	Nickel	Yes	Single point of failure	No	No.
42	Copper	No	Not applicable	No	No.
43	Beryllium	Yes	Single point of failure	Yes	No.
44	Feldspar	No	Not applicable	No	No.
45	Phosphate	No	Not applicable	No	No.
46	Silver	No	Not applicable	No	Yes.
47	Mica	No	Not applicable	No	No.
48	Selenium	No	Not applicable	No	Yes.
49	Cadmium	No	Not applicable	No	Yes.
50	Zirconium	Yes	Single point of failure	Yes	Yes.
51	Molybdenum	No	Not applicable	No	No.
52	Gold	No	Not applicable	No	No.
53	Helium	No	Not applicable	Yes	Yes.
54	Iron ore	No	Not applicable	No	No.
[7]	Cesium	Yes	Qualitative evaluation	Yes	Yes.
[7]	Erbium	Yes	Qualitative evaluation	Yes	Yes.
[7]	Europium	Yes	Qualitative evaluation	Yes	Yes.
[7]	Gadolinium	Yes	Qualitative evaluation	Yes	Yes.
[7]	Holmium	Yes	Qualitative evaluation	Yes	Yes.
[7]	Lutetium	Yes	Qualitative evaluation	Yes	Yes.
[7]	Rubidium	Yes	Qualitative evaluation	Yes	Yes.
[7]	Scandium	Yes	Qualitative evaluation	Yes	Yes.
[7]	Terbium	Yes	Qualitative evaluation	Yes	Yes.
[7]	Thulium	Yes	Qualitative evaluation	Yes	Yes.
[7]	Uranium	Not evaluated	Not applicable	Yes	No.
[7]	Ytterbium	Yes	Qualitative evaluation	Yes	Yes.

Table 1. Results of quantitative and qualitative evaluation of supply risk and the 2022 list of critical minerals. (Source: adapted from https://www.govinfo.gov/content/pkg/FR-2021-11-09/pdf/2021-24488.pdf)

[5] Ranked in order from highest to lowest risk based on a recency-weighted mean of the commodities' overall supply risk scores. See the published methodology (https://doi.org/10.3133/ ofr20211045) for further details.

[6] Most mineral commodities are recovered as byproducts to some degree, but the share of primary production as a byproduct for the mineral commodities that are not identified as byproducts in the table is typically small. Rare earth elements (REEs) are mined both as byproducts of other mineral commodities (for example, iron ore or heavy-mineral sands) and as the main product. Where REEs are mined as the main product, the individual REEs are either byproducts or coproducts of each other. For simplicity, all REEs are labeled in the table as having been produced mostly as byproducts. Byproduct status can and does change, although notable changes over short periods of time are rare.

[7] Commodities that were not evaluated using the quantitative evaluation are not given a rank and are ordered alphabetically.

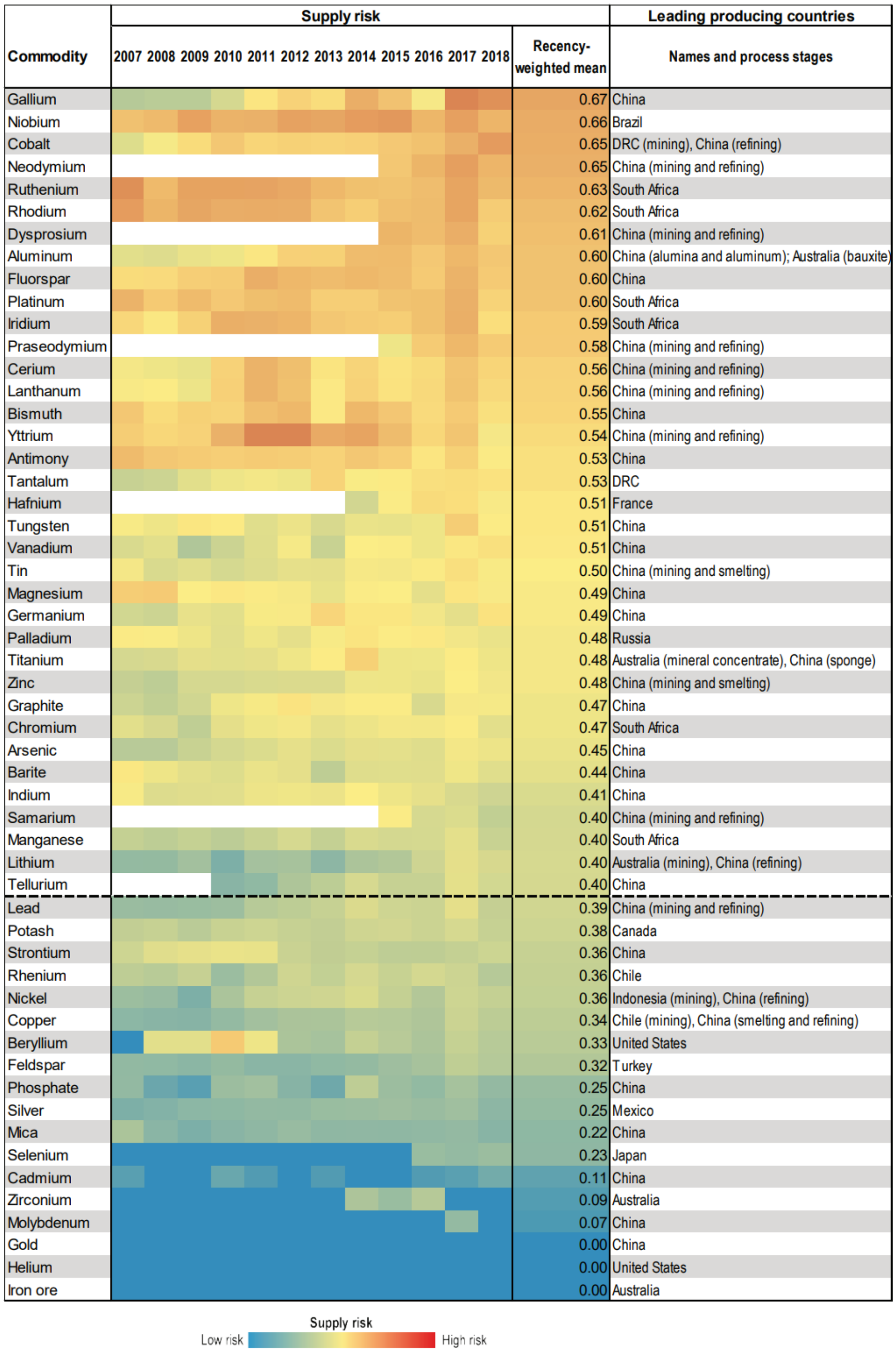

Figure 1. Supply risk for 54 commodities with sufficient data for quantitative evaluation, for the years 2007–2018. Warmer (i.e., orange to red) shades indicate a greater degree of supply risk. As indicated by the dashed horizonal line, 36 commodities with a recency-weighted mean supply risk greater than or equal to 0.40 are included on the list of critical minerals. Leading producing countries for each commodity are listed. (Source: Nassar, N.T., and Fortier, S.M., 2021, Methodology and technical input for the 2021 review and revision of the U.S. Critical Minerals List: U.S. Geological Survey Open-File Report 2021–1045, 31 p., https://doi.org/10.3133/ofr20211045.)

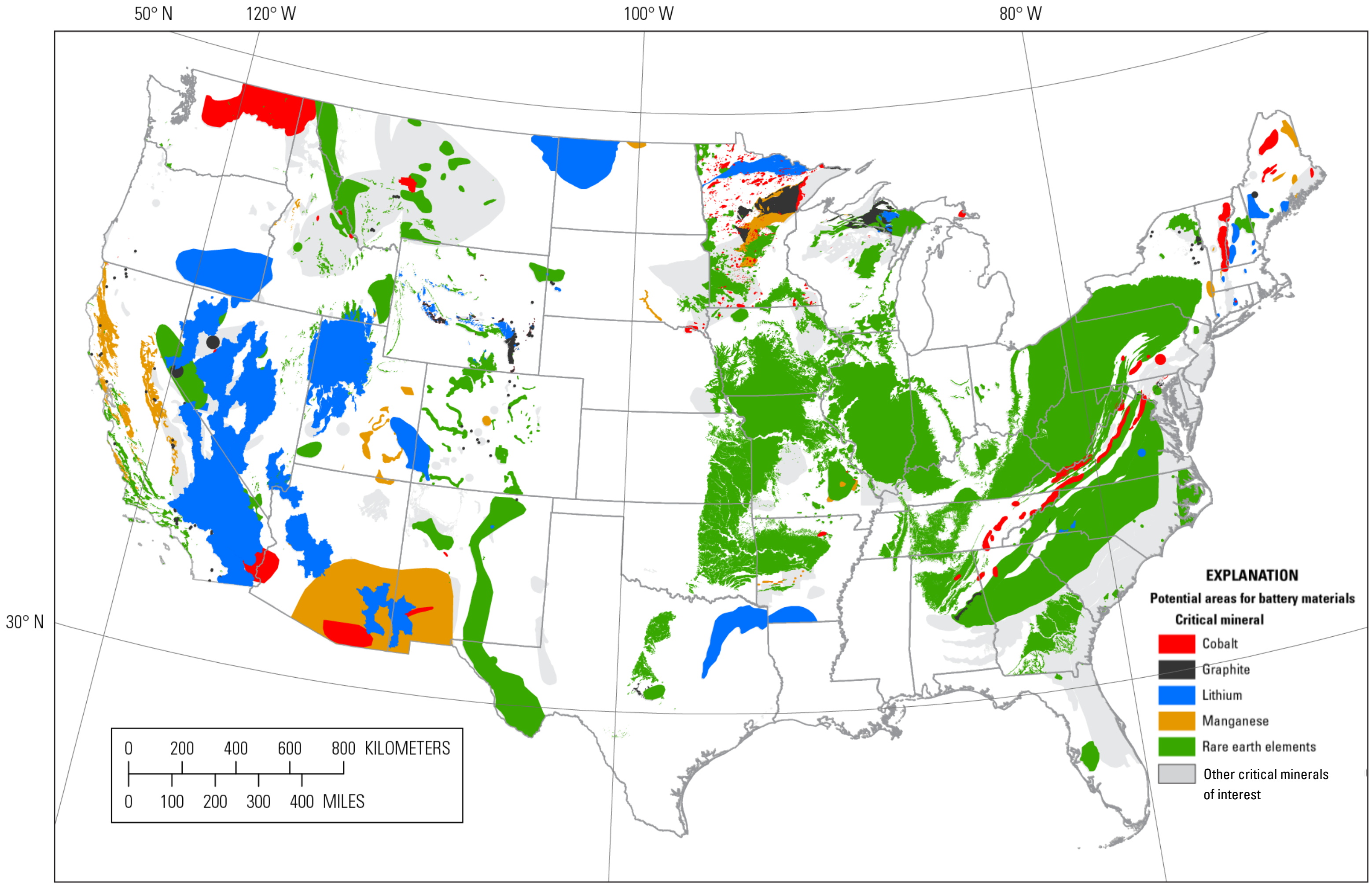

Figure 2. Areas with potential subsurface mineral resources required for high-capacity batteries (cobalt, graphite, lithium, manganese, and rare earth elements) across the conterminous United States. (Source: Dicken, C.L., and Hammarstrom, J.M., 2020, GIS for focus areas of potential domestic resources of 11 critical minerals—aluminum, cobalt, graphite, lithium, niobium, platinum group elements, rare earth elements, tantalum, tin, titanium, and tungsten: U.S. Geological Survey data release, https://doi.org/10.5066/P95CO8LR)