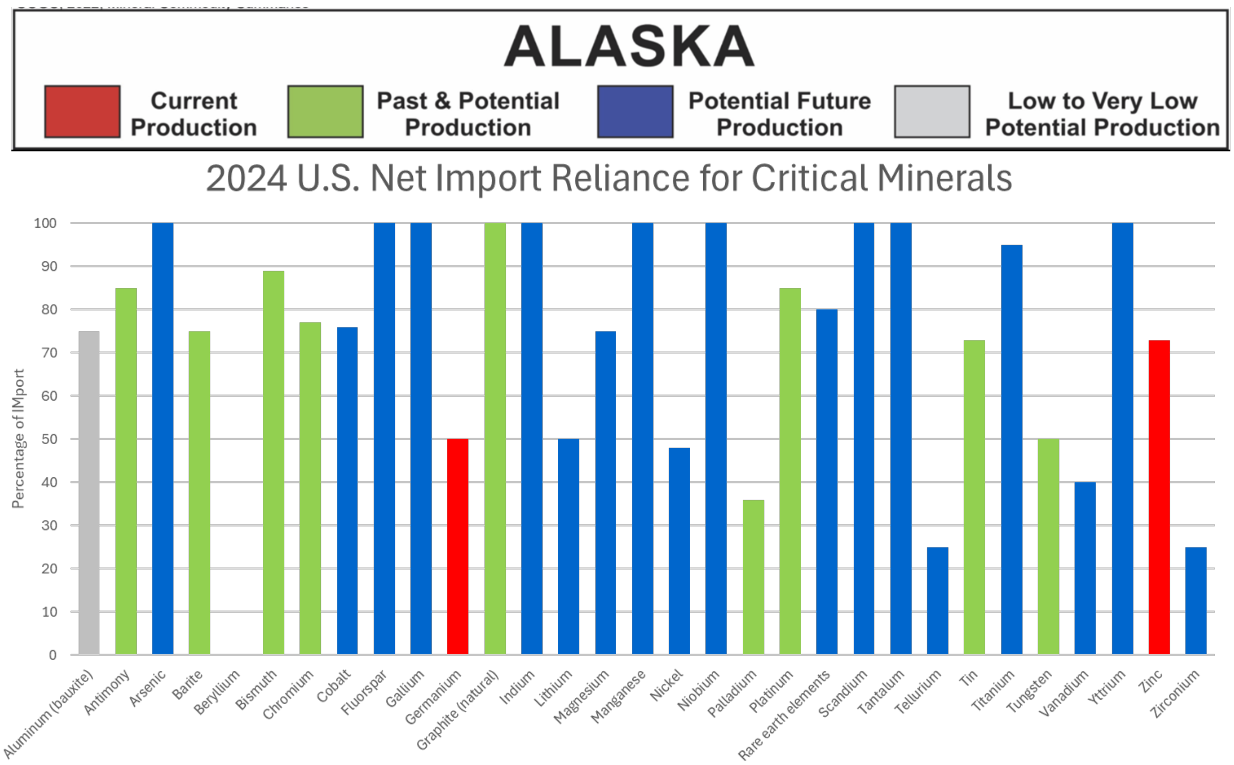
CRITICAL MINERALS, STRATEGIC MINERALS AND MINERALS IN ALASKA: A PERSPECTIVE TOWARDS FUTURE GROWTH (A REPORT TO THE ALASKA STATE LEGISLATURE REGARDING CRITICAL MINERALS)

David J. Szumigala

Special Report 78



Critical mineral production from Alaska sources. Current production of critical minerals is shown in red bars. Past production and potential future critical minerals production shown with green bars. Other critical minerals that could potentially be mined in the future from Alaska mineral resources are shown as blue bars. The gray bar for aluminum indicates that there is low to very low potential for producing aluminum from known Alaska mineral resources. Figure from Szumigala (2025b).

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Critical Minerals, Strategic Minerals and Minerals in Alaska: A Perspective Towards Future Growth (A Report to the Alaska State Legislature Regarding Critical Minerals)

David J. Szumigala

EXECUTIVE SUMMARY

In 2024, the Alaska Legislature enacted SB118, directing the state to develop a Strategic Plan for Critical and Essential Minerals. The Department of Natural Resources was tasked to provide a critical minerals report 1) comparing Alaska's current and potential future production to national and global output, 2) identifying exploration strategies to increase exploration, 3) projecting three-, five-, and ten-year production and development, 4) benchmarking permitting timelines and incentives against other jurisdictions, and 5) comparing the state's exploration incentives with other jurisdictions.

1. Comparing Alaska Mineral Production to National and Global Production

Alaska is a significant contributor to national and global mineral resources; it holds 14 percent of all U.S. metal production. Alaska produces 4.46 percent of the total mineral production value in the U.S., and half of that production value comes from critical minerals. In 2024, Alaska produced more than 42 percent of U.S. silver, 15 percent of the nation's gold, more than 80 percent of the nation's zinc, almost 42 percent of the nation's lead, and 0.15 percent of the nation's copper. Alaska's contribution to global volumes of these metals includes 1.9 percent silver, 0.73 percent gold, 5 percent zinc, 2.9 percent lead, and insignificant copper.

Of the 60 critical minerals on the 2025 U.S. List of Critical Minerals, 57 out of 60 have a possibility of being produced in Alaska. Critical minerals that have not been located in appreciable amounts in Alaska are aluminum, potash and silicon.

The Red Dog Mine in Northwest Alaska alone is the largest zinc producer in the U.S. and one of the largest zinc producers in the world. It is also one of the largest silver producers in the nation and the only U.S. germanium producer (USGS 2025). All commodities produced at the Red Dog Mine are considered critical minerals under the 2025 U.S. Critical Minerals list. The Red Dog Mine may be the largest critical mineral producer in the United States.

2. Strategies to Increase Industry Exploration for Critical and Essential Minerals

According to the Fraser Institute annual mineral industry survey rankings in 2024, Alaska is first in worldwide mineral potential based on geology and metallogenic endowment, third in investment attractiveness, and 17th in policy perception. Alaska's policy perception rank has averaged 22nd over the past two decades. This rank is roughly in the top quartile of all jurisdictions surveyed. Infrastructure quality and protected areas' uncertainty have consistently been in the lower half to lowest quartile of the survey rankings.

Mining advocacy organizations and professional boards have identified key issues to move mineral exploration forward in the state:

- *Develop effective state incentives/suggest new federal incentives*
- *Enhance availability of geologic information*
- *Fund appropriate staffing for state permitting agencies*
- *Improve infrastructure for access to land and power*
- *Develop an informed, ready workforce*

Alaska could also consider implementing programs, regulations, and legislation of other states and international jurisdictions that successfully grow mineral industry investment. Alaska could require exploration records and data to be reported to the state and made available to the public after a proprietary period. Additionally, Alaska could develop a front-end exploration tax credit and flow-through mechanisms equivalent to those in Canada, and/or additional programs to provide direct investment to exploration companies.

3. Current and Projected Production of Critical Minerals in Alaska in the Next Three, Five, and 10 years

In 2025, seven large Alaska operating mines were important producers of critical minerals zinc, lead, silver, germanium and copper. Future production at these mines can be inferred from current production and projected minelife. Increase in production of critical minerals in Alaska could occur with the opening of new mines, but due to the long timeline of mining projects, new mines are unlikely to progress from exploration to operation in the next three to five years. Three antimony-gold projects have announced production in 2026 or 2027, although these mines are small-scale and may be low volume. Therefore, overall mineral production in three years is expected to be similar to 2025. In five years, there will be decreased production at some mines, and one or more mines may begin initial production at small volumes. To begin operation within the 10-year time frame, a mine needs to be currently in permitting or under economic evaluation; 10 potential mines in Alaska meet these criteria, but any production volumes are speculative.

4. Comparison of Alaska's Permitting Timelines with Other Jurisdictions

The National Mining Association determined that the permitting process for a new mine in the U.S. averages seven to 10 years (SNL Metals & Mining, 2015). The U.S. permitting process is three to five times longer than the process in Canada and Australia.

Loeffler and Watson (2025) concluded that the average expected time to permit a new mine in the U.S. is 5.25 years (including the average expected litigation penalty). Nevada's permitting time is about one year faster than the average, while Alaska's permitting time is expected to be longer (Loeffler and Watson, 2025). In Alaska, new mines have been permitted in as little as three months, not including Environmental Impact Assessments and federal NEPA requirements, with OPMP assistance.

5. Comparison of Alaska's Exploration Incentives with Other Jurisdictions

Alaska is most similar to other U.S. states. While not all U.S. states offer direct mineral exploration incentives, many participate in federal programs or provide indirect support through permitting, infrastructure, or tax policy. States like Alaska, Nevada, and Utah lead in offering structured incentives. Alaska's innovative infrastructure financing models provided by the Alaska Industrial Development and Export Authority (AIDEA), not commonly found elsewhere in the U.S., helps to mitigate one of Alaska's biggest weaknesses – lack of infrastructure, leading to higher logistic and climate-related costs.

Alaska also resembles other U.S. states in its reliance on back-end tax deductions rather than front-end exploration support, and this places it at a disadvantage relative to Canada and Australia in the global competition for high-risk exploration capital. Canada and Australia also spend more on precompetitive geologic data to entice exploration investment. Thoughtfully designed, targeted credits or grant programs, combined with continued investment in geoscience and infrastructure, could significantly enhance Alaska's attractiveness while preserving fiscal discipline and environmental protections.

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PREFACE

The Alaska State Legislature (Legislature) passed Senate Bill 118 in 2024, amending the uncodified law by adding a new section to read: "STRATEGIC PLAN FOR CRITICAL AND ESSENTIAL MINERALS; REPORT. (a) It is the intent of the legislature that the state develop a strategy to encourage exploration, development, production, refining, and value-added manufacturing of critical and essential minerals in the state. When considering mineral economics and development and production regulatory frameworks at all levels of government, the strategy must (1) position state production of critical and essential minerals at the center of production in the United States; (2) support development of emerging technologies and the manufacturing of the required components; (3) consider the effects of different regulatory frameworks on development of critical and essential minerals in the state; and 4) maintain the state's existing environmental standards."

This legislation also tasked the Alaska Department of Natural Resources to provide a report to the Legislature regarding critical and essential minerals, specifically "comparing the state's current production and potential future production to national and global production of critical and essential minerals…" The full text of Senate Bill 118 (2014) is available in Appendix A. The following report fulfills this directive.

INTRODUCTION

Critical minerals, essential minerals, and strategic minerals are mentioned an almost daily basis in the news and recent discussions about federal and state policy. In response to these discussions and other reports highlighting Alaska's potential role in meeting the U.S. demand for domestically sourced critical minerals, the Legislature tasked the Alaska Department of Natural Resources to provide a report including the following components:

- Compare the state's current production and potential future production to national and global production of critical and essential minerals,
- Identify strategies to increase industry exploration for critical and essential minerals,
- Project state production and development of critical and essential minerals in the next three, five, and 10 years,
- Compare the state's permitting timelines with the permitting timelines in other jurisdictions, and
- Compare the state's exploration incentives and exploration incentives in other jurisdictions.

This report will review the definition of critical and essential minerals. The report will discuss Alaska's current and potential future role to provide critical and essential minerals. The bulk of the report will address the items specifically requested by the Legislature regarding incentivizing mineral industry exploration for critical minerals in Alaska and timelines for development and production of Alaska's critical minerals resources.

Critical Minerals

The terms critical materials, strategic minerals, essential minerals, and rare earth elements/minerals are used interchangeably by some news organizations and other entities. However, most of these terms are strictly defined in the U.S. by various federal organizations and/or federal law. The term "essential minerals" is not formally defined by mineral or element and is commonly used to describe critical or strategic minerals. The category "essential minerals" is interpreted to be included in this comprehensive analysis of Alaska's mineral resources, but specific minerals and elements will not be identified as essential.

The term "critical minerals" was coined in a 2008 National Research Council (NRC) report (National Research Council, 2008). The two factors used in the NRC report to rank criticality were (1) the degree to which a commodity is essential, and (2) the risk of supply disruption for the commodity. Other groups have built on those factors.

Critical minerals are essential raw materials with high economic and strategic importance, and often face supply chain vulnerabilities due to geopolitical, environmental, or market factors. The designation of a mineral as "critical" is not fixed; it varies depending on a nation's industrial priorities, technological needs, and geopolitical context.

According to Executive Order 13817 (2017), a critical mineral is a mineral identified by the U.S. Secretary of the Interior to be: (i) a non-fuel mineral or mineral material essential to the economic and national security of the U.S.; (ii) the supply chain of which is vulnerable to disruption; and (iii) that serves an essential function in the manufacturing of a product, the absence of which would have significant consequences for the economy or national security.

The Energy Act of 2020 also defines critical minerals. A critical mineral is any mineral, element, substance, or material designated as critical by the Secretary of the Interior, acting through the Director of the U.S. Geological Survey (USGS). The methodology for identifying nonfuel mineral commodities as “critical” involved a quantitative assessment based on a risk modeling framework in which commodities with the greatest supply risk were those whose (1) global production was concentrated in countries that may become unable or unwilling to continue to supply to the U.S.; (2) U.S. consumption was predominately dependent on foreign supplies; and (3) U.S. consumption represented a large expenditure for U.S. manufacturing industries with low profitability but who contributed greatly to the U.S. economy (Nassar and Fortier, 2021). The quantitative evaluation was supplemented by a semi-quantitative evaluation of whether the supply chain had a single point of failure, or a qualitative evaluation when other evaluations were not possible (USGS, 2022).

The Secretary of the Interior published a 2022 final list of critical minerals that includes the following 50 minerals: 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.

An updated list of U.S. critical minerals was published in 2025. That list and a brief discussion of the methodology used to develop it are in a subsequent section of this report titled “New 2025 List of Critical Minerals”.

Critical Materials

Critical material is a term used by the U.S. Department of Energy (DOE) as defined in the Energy Act of 2020 (DOE, 2023). The Energy Act of 2020 defines a critical material as: any non-fuel mineral, element, substance, or material that the Secretary of Energy determines: (i) has a high risk of supply chain disruption; and (ii) serves an essential function in one or more energy technologies, including technologies that produce, transmit, store, and conserve energy; or a critical mineral, as defined by the Secretary of the Interior, acting through the Director of the USGS (U.S. Congress, 2020).

DOE conducted a formal material criticality assessment to identify which materials are critical to the continued worldwide deployment of clean energy technologies (DOE, 2023). The assessment considered 38 materials used by eight major technologies, of which 23 materials were evaluated for criticality after a screening process.

The analysis identified seven materials, namely dysprosium, neodymium, gallium, graphite, cobalt, terbium, and iridium, as critical in the short term from 2020 to 2025 (fig. 1; DOE, 2023). These materials are used in various applications such as magnets, batteries, LEDs, hydrogen electrolyzers, fuel cells, and power electronics. Additionally, lithium, uranium, electrical steel, nickel, magnesium, silicon carbide, fluorine, praseodymium, and platinum were classified as near critical in the short term.

Over the medium term (2025–2035; fig. 2), the importance and supply risk scores for certain materials shift (DOE, 2023). Specifically, nickel, platinum, magnesium, silicon carbide, and praseodymium become critical primarily due to their roles in batteries and vehicle weight reductions. Aluminum, copper, and silicon become near critical in the medium term due to increased demand in solar energy technologies, global electrification, and continued vehicle weight reductions.

The final 2023 DOE Critical Materials List emphasizes critical materials for energy, included aluminum, cobalt, copper*, dysprosium, electrical steel* (grain-oriented electrical steel, non-grain-oriented electrical steel, and amorphous steel), fluorine, gallium, iridium, lithium, magnesium, natural graphite, neodymium, nickel, platinum, praseodymium, terbium, silicon*, and silicon carbide*. Materials listed with an asterisk (*) were not included in the 2023 U.S. Critical Minerals list as designated by the U.S. Secretary of the Interior.

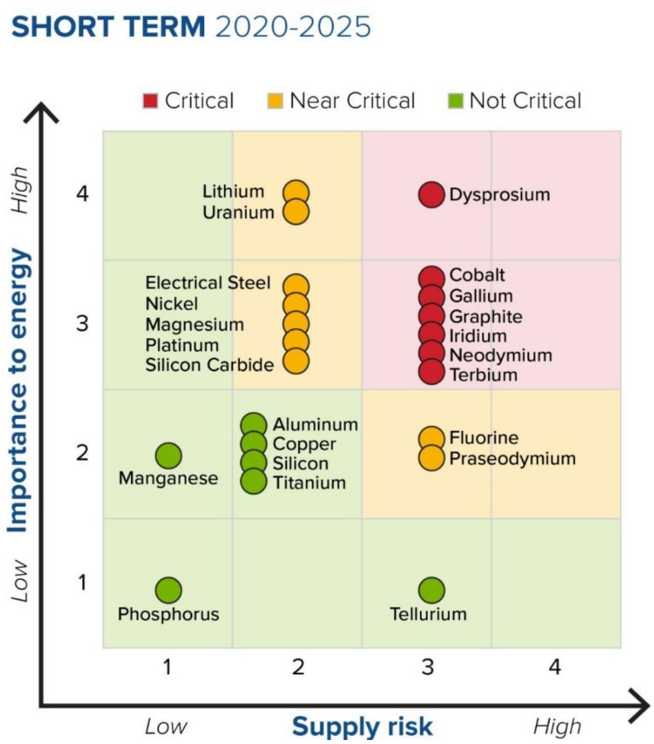

Figure 1. Short-term (2020–2025) criticality matrix (DOE, 2023).

Strategic Minerals

Strategic minerals is a term historically rooted in U.S. policy. In 1939, as World War II began and mineral supplies became stressed, Congress passed the "Strategic and Critical Materials Stock Piling Act." (USGS, 2025b). The act was intended to bolster stockpiling and build and strengthen supply chains of "certain strategic and critical materials" essential to national defense. The President was given the authority to name which materials were considered "strategic and critical" (USGS, 2025b).

The U.S. Bureau of Mines (USBM) played a foundational role in the development and management of the strategic minerals program in the United States. During World War II and the Cold War, USBM was instrumental in identifying, evaluating, and supporting the domestic production and stockpiling of strategic and critical minerals (Chappell et al., 2006).

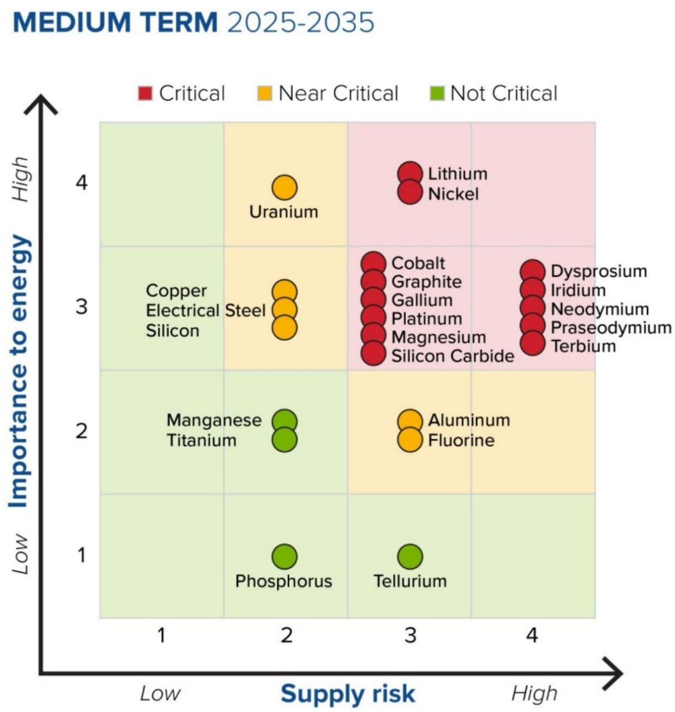

Figure 2. Medium-term (2025–2035) criticality matrix (DOE, 2023).

Strategic minerals were stockpiled to ensure supply during geopolitical tensions of the Cold War Era (1940s-1980s). The U.S. focused on securing materials like chromium, cobalt, manganese, and rare earth elements (Rabbitt, 1990).

The Strategic and Critical Materials Stock Piling Revision Act of 1979 defined critical and strategic minerals as materials that (1) would be needed to supply the military, industrial, and essential civilian needs of the U.S. during a national defense emergency, and (2) are not found or produced in the U.S. in sufficient quantities to meet such needs (Defense Logistics Agency, 2024).

As a major part of the mineral studies mandated under the Alaska National Interest Lands Conservation Act, USBM and USGS evaluated economic and subeconomic reserves of critical and strategic minerals in Alaska during the 1980s (Barker et al., 1982). USBM investigated areas of Alaska for antimony, cobalt, chromite, columbite (niobium and tantalum), platinum-group metals, tin, tantalum. and tungsten.

Rare-Earth Elements (Rare-Earth Minerals)

Rare-earth elements are 16 metallic elements with similar physical and chemical properties. The 16 rare-earth elements are yttrium (Y), and the 15 lanthanides. The lanthanides include lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), and lutetium (Lu). Rare-earth elements are often informally subdivided into “heavy rare earths” and “light rare earths” based on atomic number. Lanthanum, cerium, praseodymium, neodymium, promethium and samarium, with atomic numbers 57 through 62, are generally referred to as the “light rare earths.” Yttrium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium, with atomic numbers 39 and 63 through 71, are generally considered the “heavy rare earths.” Although the atomic number for yttrium falls outside of the defined ranges for rare-earth elements, it is categorized as heavy due to its chemical and physical associations with heavy rare earths in natural deposits (Van Gosen et al., 2017). Scandium (Sc) is not a rare-earth element, but it is commonly grouped with heavy rare-earth elements because of its behavior and occurrence. Figure 3 shows the distribution of rare-earth elements in the periodic table.

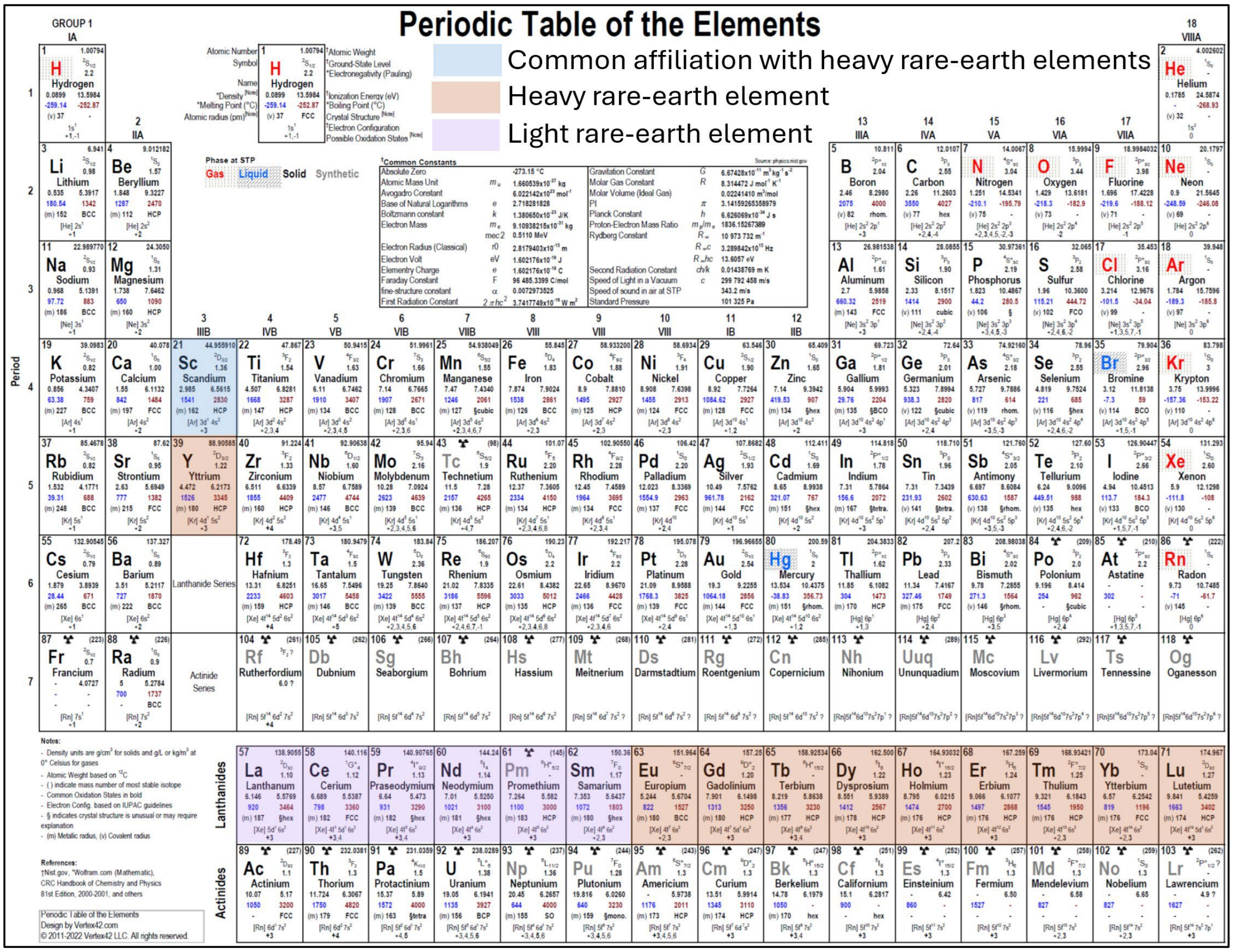

Figure 3. Periodic table of the elements with rare-earth elements highlighted. All rare-earth elements except yttrium are in the lanthanide series of elements. Scandium is often grouped with rare-earth elements. Base image from Vertex42.com.

Rare-earth elements have been considered critical minerals and strategic minerals for many years. They are a subset of critical minerals lists for most countries. A brief review of rare-earth elements and Alaska's potential rare-earth element resources is found in Szumigala and Werdon (2011).

2025 U.S. List of Critical Minerals

The U.S. Department of the Interior, through USGS, released the draft 2025 List of Critical Minerals in August 2025 with a report that outlines a new methodology for assessing how potential supply chain disruptions could affect the U.S. economy (USGS, 2025d). The new USGS methodology modeled more than 1,200 trade disruption scenarios across 84 mineral commodities (Nassar et al., 2025). This analysis examined the impact of supply interruptions on U.S. gross domestic product (GDP) across various industries.

Minerals-based industries contributed over $4 trillion to the U.S. economy in 2024 (USGS, 2025). The new methodology pinpoints industries that may feel the greatest impacts of supply disruptions and identifies strategic domestic investments or international trade relationships that may help mitigate risk to individual supply chains (Nassar et al., 2025). Some of the findings of the new USGS methodology are summarized in figure 4. The graph plots the net decrease in the U.S. GDP versus the median probability of a scenario occurring; that is, the financial impact to the U.S. GDP for mineral or material versus the likelihood that the availability of that mineral or material may be disrupted. Minerals that plot higher on the graph have more of a financial impact to the U.S. GDP. Minerals that plot more to the right on the graph are more likely to have supplies disrupted or lost.

Based on the USGS methodology, the USGS identified rhodium, gallium, germanium, tungsten, niobium, magnesium, potash, and several rare earths as having the highest economic and supply risks (Nassar et al., 2025). The modeling identified 54 commodities as critical, including adding potash, silicon, copper, silver, rhenium, and lead (USGS, 2025d).

The 2025 draft list included 54 mineral commodities, of which 50 were included based on the results of the economic effects assessment. Zirconium was included because of the potential for a single point of failure within the domestic supply chain. Cesium, rubidium, and scandium were retained from the 2022 Critical Minerals List based on a qualitative evaluation.

President Trump's Executive Order "Reinvigorating America's Beautiful Clean Coal Industry and Amending Executive Order 14241 (2025)" tasked the Secretary of Energy to determine if coal used in steel production meets the definition of a critical material under the Energy Act of 2020. Review of the current U.S. steel market and its reliance on metallurgical coal (including anthracite) revealed a production scenario on track for significant import reliance (DOE, 2025b). Meeting the policy goal of U.S. steel dominance will require dramatic increases in domestic metallurgical coal production and use. This analysis supported designating metallurgical coal used for steelmaking as a DOE critical material (DOE, 2025b).

Public comment and agency review of the draft list resulted in six additions to the final 2025 List of Critical Minerals. The U.S. Department of Defense (DOD) recommended keeping arsenic and tellurium on the list. The U.S. Department of Agriculture recommended adding phosphate, DOE recommended adding metallurgical coal and uranium, and industry supported adding boron (USGS, 2025c).

The final U.S. 2025 List of Critical Minerals includes 60 critical minerals (USGS, 2025c), listed in Table 1. Appendix B lists the 60 critical minerals by industry category and includes some characteristics of each critical mineral.

Table 1. 2025 U.S. List of Critical Minerals (modified from U.S. Geological Survey, 2025c).

2025 U.S. List of Critical Minerals			
Aluminum	Fluorspar	Metallurgical Coal	Silicon
Antimony	Gadolinium	Neodymium	Silver
Arsenic	Gallium	Nickel	Tantalum
Barite	Germanium	Niobium	Tellurium
Beryllium	Graphite	Palladium	Terbium
Bismuth	Hafnium	Phosphate	Thulium
Boron	Holmium	Platinum	Tin
Cerium	Indium	Potash	Titanium
Cesium	Iridium	Praseodymium	Tungsten
Chromium	Lanthanum	Rhenium	Uranium
Cobalt	Lead	Rhodium	Vanadium
Copper	Lithium	Rubidium	Ytterbium
Dysprosium	Lutetium	Ruthenium	Yttrium
Erbium	Magnesium	Samarium	Zinc
Europium	Manganese	Scandium	Zirconium

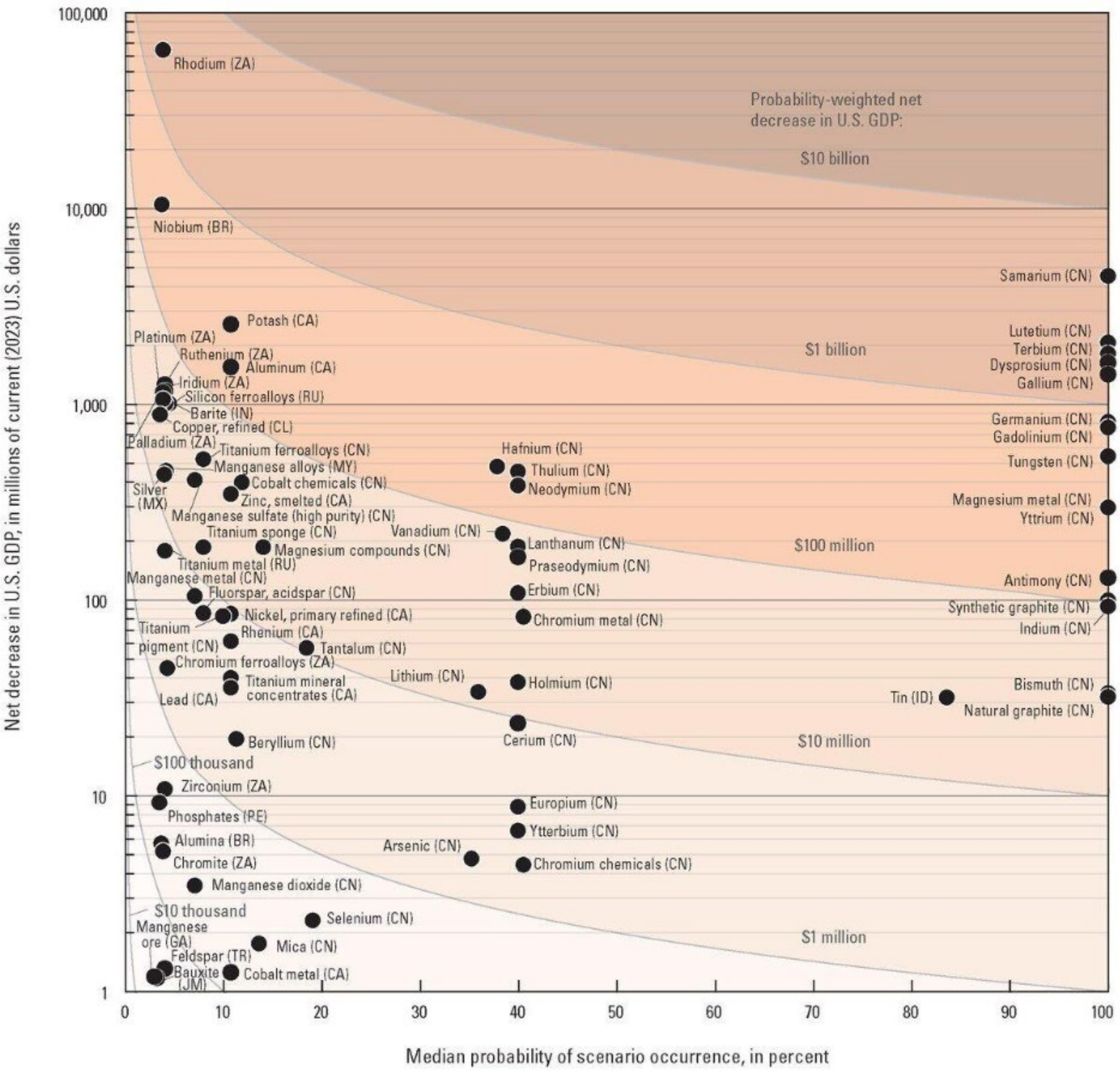

Figure 4. USGS methodology for quantitatively assessing criticality of certain minerals (Nassar et al., 2025). Graph shows net decreases in U.S. GDP and median probability of occurrence for the leading trade disruption scenario for 72 of the 84 mineral commodities examined. Vertical axis is displayed in a logarithmic scale. Point labels display the mineral commodity, followed by the restricting country in parentheses: BR, Brazil; CA, Canada; CL, Chile; CN, China; GA, Gabon; ID, Indonesia; IN, India; JM, Jamaica; MX, Mexico; MY, Malaysia; PE, Peru; RU, Russia; TR, Turkey; ZA, South Africa.

Critical Minerals Globally

Globally, the designation of a mineral or material as critical is not fixed; it varies depending on a nation's industrial priorities, technological needs, and geopolitical context. Table 2 is a comparison of the U.S. critical minerals list to those of selected worldwide jurisdictions. While many minerals on the lists are similar, each list varies in the specific minerals and number of minerals considered critical. These lists will change over time.

Table 2. Current critical mineral lists for the U.S. and select global jurisdictions. Many minerals are considered critical by most jurisdictions. Data from USGS (2025), Hickin et al. (2023), International Energy Agency (2023), Grohol and Veeh (2023), Geoscience Australia (2025b), India Ministry of Mines (2023), and Critical Minerals Association (2024).

Critical mineral (date of list)	United States (2025)	Canada (2024)	European Union (2023)	Australia (2023)	Japan (2020)	United Kingdom (2023)	India (2023)	South Korea (2023)
Aluminum	■	■		■				■
Antimony	■	■	■	■	■	■	■	■
Arsenic	■		■	■				
Barite/Barium	■		■		■			
Bauxite			■					
Beryllium	■		■	■	■		■	
Bismuth	■	■	■	■	■	■	■	■
Boron/Borate	■		■		■			
Cadmium							■	
Cesium	■	■			■			
Chromium	■	■		■	■			■
Cobalt	■	■	■	■	■	■	■	■
Copper	■	■	■				■	■
Feldspar			■					
Fluorspar/Fluorine	■	■	■	■	■			
Gallium	■	■	■	■	■	■	■	■
Germanium	■	■	■	■	■		■	
Graphite	■	■	■	■	■	■	■	■
Hafnium	■		■	■	■		■	
Helium			■					
High-purity iron ore		■						
Indium	■	■		■	■	■	■	■
Lead	■							■
Lithium	■	■	■	■	■	■	■	■
Magnesium	■	■	■	■	■	■		■
Manganese	■	■	■	■	■			■
Metallurgical/Coking Coal	■		■					
Molybdenum		■		■	■		■	■
Nickel	■	■	■	■	■		■	■
Niobium	■	■	■	■	■	■	■	■
Phosphate	■		■					
Phosphorus		■	■				■	
Platinum group metals	■	■	■	■	■	■	■	■
Potash	■	■					■	

Critical mineral (date of list)	United States (2025)	Canada (2024)	European Union (2023)	Australia (2023)	Japan (2020)	United Kingdom (2023)	India (2023)	South Korea (2023)
Rare earth elements	X	X	X	X	X	X	X	X
Rhenium	X			X	X		X	
Rubidium	X				X			
Scandium	X	X	X	X				
Selenium				X	X		X	X
Silicon metal	X	X	X	X	X	X	X	X
Silver	X							
Strontium			X		X		X	X
Tantalum	X	X	X	X	X	X	X	X
Tellurium	X	X		X	X	X	X	
Thallium					X			
Tin	X	X					X	X
Titanium	X	X	X	X	X		X	X
Tungsten	X	X	X	X	X	X	X	X
Uranium	X	X			X			
Vanadium	X	X	X	X	X	X	X	X
Zinc	X	X						X
Zirconium	X			X	X		X	X

Note: United States specifies platinum, palladium, rhodium, ruthenium, and iridium as critical minerals. These have been grouped as platinum-group metals. United States also lists each rare-earth element as a critical mineral. These 17 elements have been grouped as rare-earth elements in this table.

Many minerals are critical to all jurisdictions because these minerals are essential for many technologies. These critical minerals are influencing foreign policy and investment strategies.

Global demand for critical minerals is accelerating, driven by the transition to clean energy and digital technologies (Hund et al., 2023). Demand for minerals like lithium and cobalt could grow by up to 40 times by 2040 under certain climate scenarios (International Energy Agency, 2021). However, their extraction and processing are often concentrated in a few countries, raising concerns about supply security, environmental sustainability, and ethical sourcing. As such, governments and industries are increasingly focused on diversifying supply chains, investing in domestic production, and promoting recycling and substitution strategies. For example, the U.S. and European Union have launched strategic initiatives to diversify sources and reduce dependency on single suppliers (DOE, 2021; European Commission, 2023).

The 2025 U.S. List of Critical Minerals includes minerals that vary greatly in annual production and market supply. Global production of critical minerals varies widely based on geologic resources and market demand. Annual production of minerals such as copper and zinc is measured in millions of tons, whereas annual production of minerals such as indium and palladium is measured in hundreds of tons.

The vast variance in market size leads to variability in potential market manipulation. A large commodity market with multiple players is difficult, if not impossible, to manipulate because it is so open. However, a small market with just a few producers is easily manipulated. For example, China controls the worldwide supply of rare-earth elements, graphite, tungsten, gallium, germanium, cobalt, and magnesium (Gulley, 2024; USGS, 2025). In recent years China has manipulated those markets to stifle competition.

For countries that hold a virtual monopoly on a resource, prices are vulnerable to changes in supply. For example, China, the world's largest producer of tungsten, flooded the market in the early 2000s causing prices to fall and leading to the closure of several tungsten mines in other countries (Monet, 2012). The drop in value also triggered a sharp decline in tungsten exploration spending. A decade later, China began restricting exports of domestically produced tungsten and importing the metal from other countries, creating a global shortage and leading to a major increase in price (Monet, 2012).

One metric defining the criticality of a mineral or material is the reliance on importing that mineral or material to meet current or near-future demand for that commodity. Figure 7 from USGS (2025) illustrates the reliance of the U.S. on foreign sources for raw and processed mineral materials. The commodities listed are a mix of critical minerals and non-critical minerals. In 2024, imports made up more than one-half of the U.S. apparent consumption for 46 nonfuel mineral commodities. Of the 50 mineral commodities identified in the 2022 List of Critical Minerals, the U.S. was 100 percent net import reliant for 12, and an additional 28 critical mineral commodities (including yttrium and 14 lanthanides, which are listed under rare-earth elements) had a net import reliance greater than 50 percent of apparent consumption (USGS, 2025).

China was the leading producing country for 30 of 44 critical minerals (including yttrium and 14 lanthanides, which are listed under rare earths) for which information was available to USGS to make reliable estimates (USGS, 2025). The other leading producing countries of critical minerals were South Africa with three critical minerals and Australia and the Democratic Republic of Congo with two critical minerals each (fig. 5). Production of several critical minerals in 2024 was highly concentrated (50 percent or more) in a single country. Five critical minerals had 80 percent or more of global production dominated by one country, six critical minerals had 70 percent to less than 80 percent of global production dominated by one country, 17 critical minerals (including 14 lanthanides, which are listed under rare earths) had 60 percent to less than 70 percent of global production dominated by one country, and two critical minerals had 50 percent to less than 60 percent of global production dominated by one country (fig. 5).

Figure 6 is another representation of USGS mineral commodity data for 2024. This graph focuses on 44 U.S. critical minerals. Ten of these critical minerals are currently 100 percent imported, while 37 critical minerals are 50 percent or more net import reliant (USGS, 2025).

Geologic Sources of Critical Minerals

Critical minerals form by the same wide variety of geologic processes under which all mineral resources form and can be associated with other mineral commodities in their host rocks. A good summary of the many ore-forming environments that contain critical minerals is the USGS summary of mineral deposit models (Cox and Singer, 1986). Some critical minerals are the main or major commodities mined at a specific mine, but more commonly, critical minerals are coproducts or by-products of the principal mineral or commodity being produced. In many cases, a critical mineral would not be economically mined without the value of the associated principal commodity.

A "mineral occurrence" is a concentration of a mineral, usually but not necessarily considered in terms of some commodity such as copper, barite or gold, that is considered valuable or that is of scientific or technical interest (Cox and Singer, 1986). A "mineral deposit" is a mineral occurrence of sufficient size and grade that might, under the most favorable of circumstances, be considered to have economic potential.

An "ore deposit" is a mineral deposit that has been tested and is known to be of sufficient size, grade, and accessibility to be producible and to yield a profit (Cox and Singer, 1986). Whether a mineral deposit is an ore deposit greatly depends on the value of the ore minerals and all logistical and financial factors that affect profitability.

Commodity	Net import reliance as a percentage of apparent consumption in 2024	Leading import sources (2020–23)[2]
ARSENIC, all forms	100	China,[3] Morocco, Malaysia, Belgium
ASBESTOS	100	Brazil, Russia
CESIUM	100	Germany, China
FLUORSPAR	100	Mexico, Vietnam, South Africa, China[3]
GALLIUM, metal	100	Japan, China, Germany, Canada
GRAPHITE (NATURAL)	100	China,[3] Canada, Mexico, Mozambique
INDIUM	100	Republic of Korea, Japan, Canada, Belgium
MANGANESE	100	Gabon, South Africa, Australia, Malaysia
MICA (NATURAL), sheet	100	China, Brazil, India
NIOBIUM (COLUMBIUM)	100	Brazil, Canada
RUBIDIUM	100	China, Germany, Russia
SCANDIUM	100	Japan, China, Philippines
STRONTIUM	100	Mexico, Germany
TANTALUM	100	China,[3] Australia, Germany, Indonesia
YTTRIUM, compounds	100	China,[3] Germany
GEMSTONES	99	India, Israel, Belgium, South Africa
ABRASIVES, fused aluminum oxide	>95	China,[3] Canada, Brazil, Austria
NEPHELINE SYENITE	>95	Canada
TITANIUM, sponge metal	>95	Japan, Kazakhstan, Saudi Arabia
POTASH	93	Canada, Russia, Belarus, Israel
BISMUTH, metal, alloys, and scrap	89	China,[3] Republic of Korea
IRON OXIDE PIGMENTS, natural and synthetic	87	China,[3] Germany, Brazil, Canada
TITANIUM MINERAL CONCENTRATES	86	South Africa, Madagascar, Canada, Australia
ANTIMONY, metal and oxide	85	China,[3] Belgium, India, Bolivia
PLATINUM	85	South Africa, Belgium, Germany, Italy
STONE (DIMENSION)	83	Brazil, China,[3] Italy, Turkey
DIAMOND (INDUSTRIAL), stones	81	India, South Africa, Russia, Australia
RARE EARTHS,[4] compounds and metals	80	China,[3] Malaysia, Japan, Estonia
PEAT	78	Canada
CHROMIUM, all forms	77	South Africa, Kazakhstan, Canada, Finland
COBALT, metal, oxides, and salts	76	Norway, Finland, Japan, Canada
BARITE	>75	India, China,[3] Morocco, Mexico
BAUXITE	>75	Jamaica, Turkey, Guyana, Australia
MAGNESIUM METAL	>75	Israel, Canada, Turkey, Czechia
TIN, refined	73	Peru, Bolivia, Indonesia, Brazil
ZINC, refined	73	Canada, Mexico, Republic of Korea, Peru
ABRASIVES, silicon carbide	69	China,[3] Brazil, Canada
RHENIUM	65	Chile, Canada, Germany, Poland
SILVER	64	Mexico, Canada, Republic of Korea, Poland
ALUMINA	59	Brazil, Jamaica, Australia, Canada
MAGNESIUM COMPOUNDS	52	China,[3] Israel, Brazil, Canada
GERMANIUM	>50	Belgium, Canada, China, Germany
IODINE	>50	Chile, Japan
LITHIUM	>50	Chile, Argentina
SELENIUM, metal	>50	Philippines, Mexico, Canada, Poland
TUNGSTEN	>50	China,[3] Germany, Bolivia, Vietnam
SILICON, metal and ferrosilicon	<50	Brazil, Russia, Canada, Malaysia
GARNET (INDUSTRIAL)	48	South Africa, Australia, India, China[3]
NICKEL	48	Canada, Norway, Australia, Brazil
ALUMINUM	47	Canada, United Arab Emirates, Bahrain, China[3]
DIAMOND (INDUSTRIAL), bort, grit, and dust and powder	47	China,[3] Republic of Korea, Ireland, Russia
COPPER, refined	45	Chile, Canada, Mexico, Peru
MICA (NATURAL), scrap and flake	41	China, Canada, India, Finland
VANADIUM	40	Canada, Brazil, Austria, South Africa
PALLADIUM	36	Russia, South Africa, Belgium, Italy
VERMICULITE	34	South Africa, Brazil, Zimbabwe
FELDSPAR	33	Turkey, Mexico
LEAD, refined	28	Canada, Republic of Korea, Mexico, Australia
PERLITE	26	Greece, China
BROMINE	<25	Israel, Jordan, China[3]
TELLURIUM	<25	Canada, Philippines, Japan, Germany
ZIRCONIUM, ores and concentrates	<25	South Africa, Australia, Senegal
SALT	24	Canada, Chile, Mexico, Egypt
CEMENT	22	Turkey, Canada, Vietnam, Greece

Figure 5. 2024 U.S. Net Import Reliance for Mineral Commodities (from USGS, 2025). Leading import sources listed are limited to four.

Ore minerals and metals, with critical minerals as a subset, are very minor constituents of the Earth's crust. Earth's outermost layer is composed of 92 elements, with oxygen comprising 46.7 percent of the mass, and silicon comprising 27.7 percent of the mass (Clarke, 1924). The next most abundant elements in the crust are aluminum, iron, calcium, sodium, potassium, and magnesium. These elements comprise 24.2 percent of the earth's crustal material (Clarke, 1924). Those eight elements total 98.6 percent of the earth's crustal material by weight. The remaining 84 elements, including ore metals and most critical minerals, account for 1.4 percent of the Earth accessible to humans.

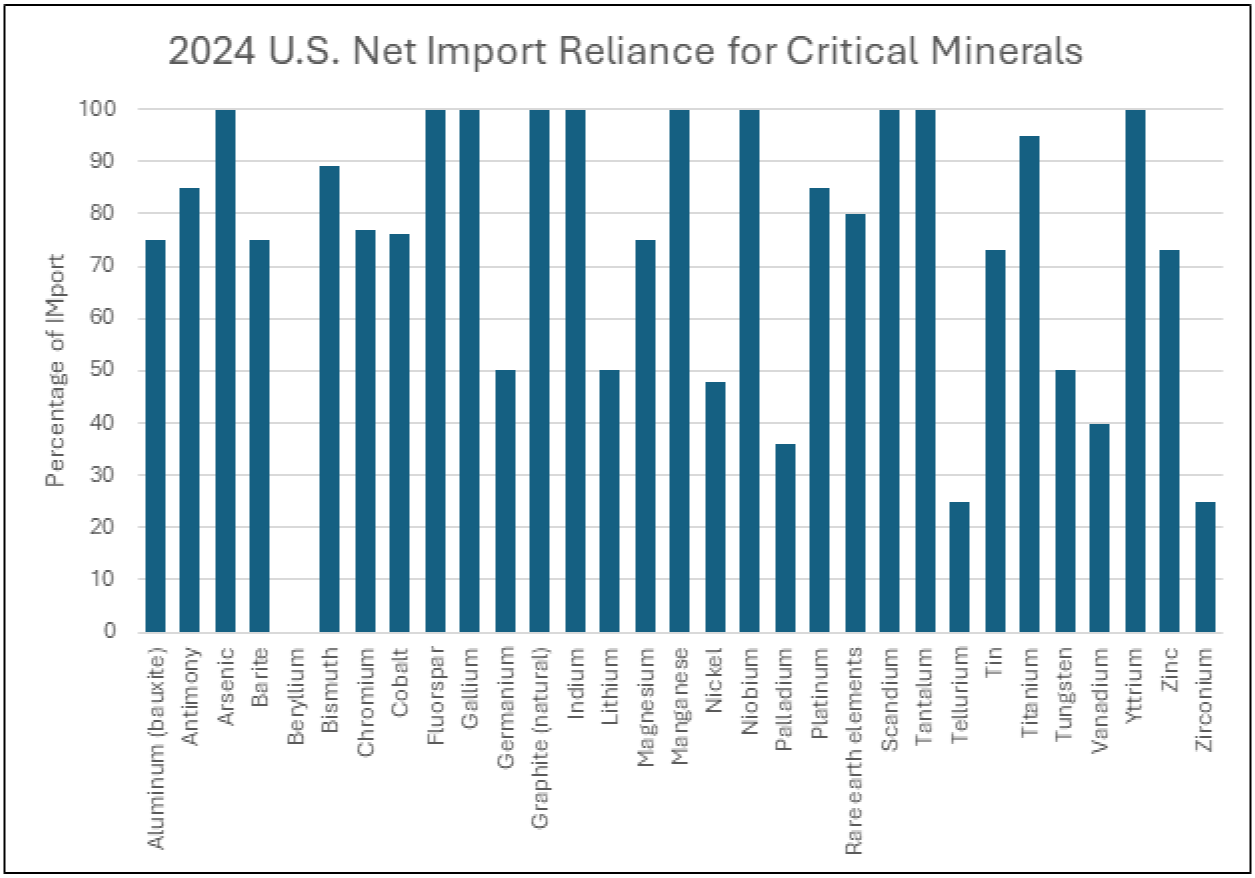

Figure 6. U.S. net reliance on imported critical minerals in 2024. Modified from USGS (2025).

Critical minerals are generally associated with other metals and commodities. Figure 7 from USGS (2025) shows the relationship between primary metals and byproduct or companion metals. Many of the primary metals are considered critical minerals in the U.S., as are most of the byproduct or companion metals. The principal host metals (major metals of interest) form the inner circle on Figure 7. Byproduct elements are in the outer circle at distances proportional to the percentage of their primary production (from 100 percent to 0 percent) that originates with the host metal indicated. The companion elements in the white region of the outer circle (marked 0%) are elements for which the percentage of their production that originates with the host metal indicated has not been determined. For example, aluminum (Al) is the major commodity sought in laterite deposits. Aluminum, in the inner circle, is 100 percent associated with gallium (Ga), and 10 to 25 percent of aluminum production is associated with vanadium (V). The situation is much more complicated with copper (Cu) production. Eighteen elements, ranging from unknown to 100 percent of their production, are associated with copper.

The degree to which a metal is obtained largely or entirely as a byproduct of one or more host metals from ores may complicate the supply of these mineral commodities (Nassar and Fortier, 2021). Most minor metals are geologically closely connected to certain major metal deposits, so their production depends heavily on that host metal. For example, selenium is primarily recovered as a byproduct from copper refining, although it's also found in coal, phosphate, and other metal ores. Copper is produced as a byproduct of platinum and nickel mining, but copper is the principal commodity in most mining operations in which it is recovered. The total tonnage of copper produced as a primary commodity, such as at porphyry copper deposits, dwarfs the tonnage of copper produced as a byproduct.

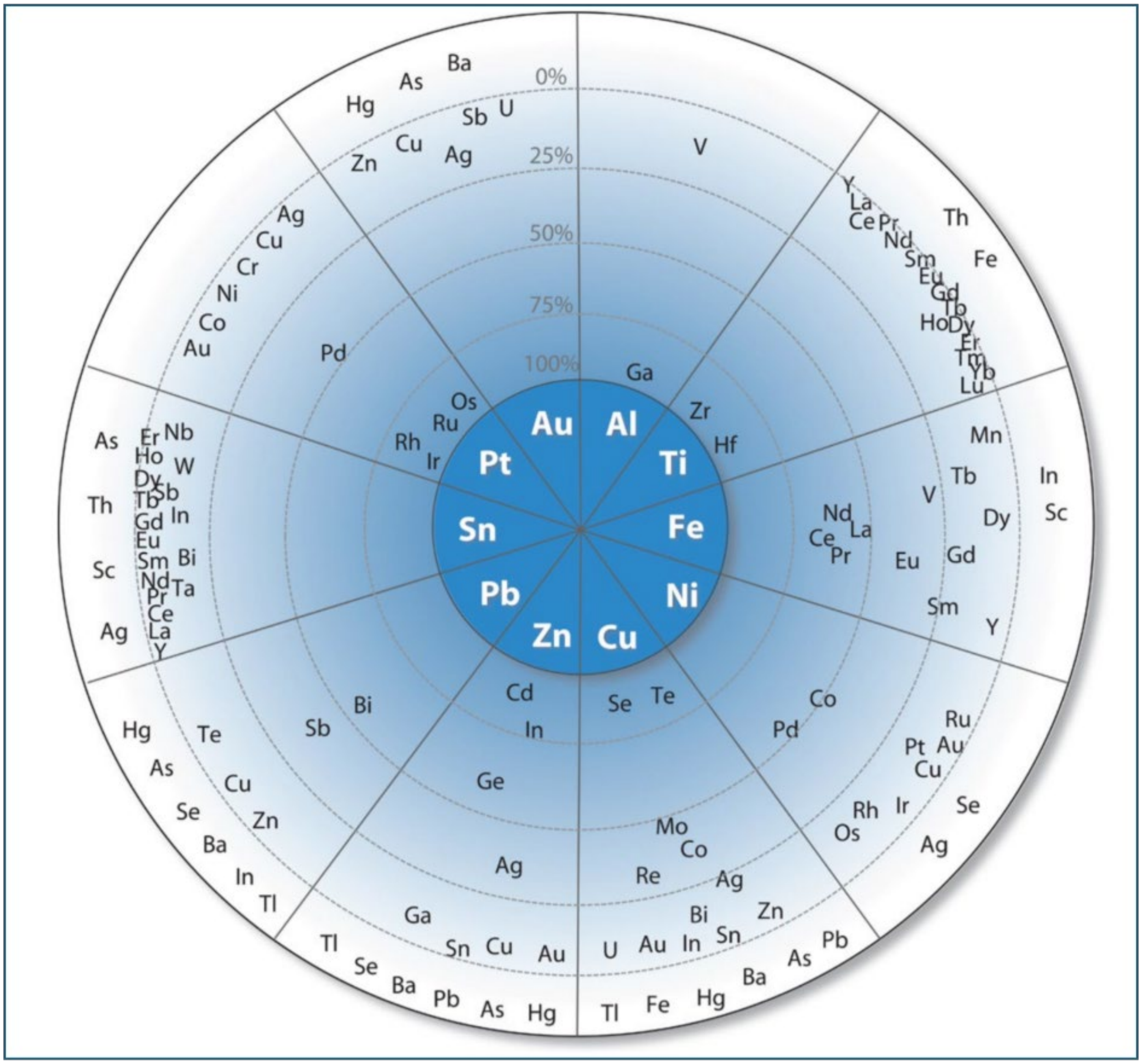

Figure 7. Relationship between byproduct elements and host metals. rarely mined without mining the host metals. Al, aluminum; Ag, silver; As, arsenic; Au, gold; Ba, barium; Bi, bismuth; Cd, cadmium; Ce, cerium; Co, cobalt; Cr, chromium; Cu, copper; Dy, dysprosium; Er, erbium; Eu, europium; Fe, iron; Ga, gallium; Gd, gadolinium; Ge, germanium; Hf, hafnium; Hg, mercury; Ho, holmium; In, indium; Ir, iridium; La, lanthanum; Lu, lutetium; Mn, manganese; Mo, molybdenum; Nd, neodymium; Ni, nickel; Os, osmium; Pb, lead; Pd, palladium; Pt, platinum; Pr, praseodymium; Re, rhenium; Rh, rhodium; Ru, ruthenium; Sb, antimony; Sc, scandium; Se, selenium; Sm, samarium; Sn, tin; Ta, tantalum; Tb, terbium; Te, tellurium; Th, thorium; Ti, titanium; Tl, thallium; U, uranium; V, vanadium; W, tungsten; Y, yttrium; Yb, ytterbium; Zn, zinc; Zr, zirconium (USGS, 2025).

COMPARING ALASKA'S CURRENT PRODUCTION AND POTENTIAL FUTURE PRODUCTION TO NATIONAL AND GLOBAL PRODUCTION OF CRITICAL AND ESSENTIAL MINERALS

Alaska 2024 Mineral Production versus Domestic and Global Production

Alaska is a major U.S. mineral producer, especially for gold, lead, silver, and zinc, with additional output of germanium, copper, coal, sand, gravel, and industrial minerals. The value of Alaska's nonfuel (excluding coal) mineral production in 2024 was $4.71 billion (USGS, 2025). Alaska ranked sixth in the U.S. in nonfuel mineral production and contributed 4.46 percent of the U.S. total mineral production value. The top 10 producing states (based on total value including withheld values) were, in descending order of non-fuel production value, Nevada, Texas, Arizona, California, Minnesota, Alaska, Florida, Wyoming, Utah, and Missouri (USGS, 2025).

Metal production is a subset of nonfuel mineral production. U.S. metal production in 2024 totaled $33.5 billion (USGS, 2025). Alaska's metal production value of $4.69 billion was approximately 14 percent of the U.S. total. Approximately 50 percent of Alaska's metal production value came from critical minerals.

Gold

Gold is not a critical mineral, but it is associated with many critical minerals like silver, tellurium, bismuth, arsenic, and antimony. In 2024, domestic gold mine production was estimated to be 176 tons, and the value of gold production was estimated to be $12 billion, a nine percent increase from the 2023 value (USGS, 2025). Gold was produced at more than 40 lode mines in 12 states, at several large placer mines in Alaska, and at numerous smaller placer mines mostly in Alaska and in the Western U.S. (USGS, 2025). Nevada was the leading gold-producing state, accounting for about 70 percent of total domestic production, followed by Alaska, which produced about 16 percent of domestic gold (USGS, 2025). The major Alaska gold producers are Kinross Alaska's Fort Knox Mine, Northern Star Resources' Pogo Mine, the Manh Choh Mine jointly owned by Kinross Alaska and Contango Ore, Coeur Alaska's Kensington Mine, Hecla's Greens Creek Mine, and Sundance Group's Dawson Mine.

Lead

Lead was produced domestically by five lead mines in Missouri plus as a co-product at two zinc mines in Alaska and two silver mines in Idaho (USGS, 2025). The value of recoverable lead from domestic ore mined in 2024 was an estimated $670 million compared with $660 million in 2023 (USGS, 2025). Alaska's 2024 lead production was 42 percent of the lead ore mined in the U.S. Teck Alaska's Red Dog Mine is the largest lead producer in the state, followed by Hecla's Greens Creek Mine.

Silver

In 2024, U.S. mines produced approximately 1,200 tons of silver with an estimated value of $960 million (USGS, 2025). Silver was produced at four silver mines and as a byproduct or coproduct from 31 domestic base- and precious-metal operations. Silver was produced in 12 states, and Alaska continued as the country's leading silver-producer followed by Idaho (USGS, 2025). Greens Creek Mine is the largest silver producer in Alaska and the U.S., with slightly less silver produced at Red Dog Mine, and minor amounts of silver produced at several Alaska gold mines.

Zinc

The estimated value of zinc mined in the U.S. in 2024 was $2.4 billion (USGS, 2025). Zinc was mined in five states at six mining operations by five companies. Two smelter facilities, one primary and one secondary, operated by two companies, accounted for most of the commercial-grade zinc metal produced (USGS, 2025). U.S. zinc production is estimated to have decreased slightly in 2024 compared with that in 2023 (USGS, 2025). Middle Tennessee zinc mines suspended operations in November 2023. Alaska's 2024 zinc production from Red Dog Mine and Greens Creek Mine accounted for more than 80 percent of U.S. zinc production. Red Dog Mine is the largest zinc producer in the country and one of the largest zinc producers in the world.

Germanium

Zinc concentrates containing germanium were produced at Alaska and Tennessee mines in 2023, with Red Dog Mine being the only domestic producer in 2024 (USGS, 2024, 2025). Some of the germanium-containing concentrates produced in Alaska from Red Dog Mine were exported to a refinery in Canada for processing and germanium recovery. Global germanium refinery production and recycling data were limited, and available estimates were difficult to verify by USGS (2024).

Other Critical Minerals

Although Alaska has large resources of copper and was a significant copper producer in the past, it currently produces minor amounts compared to domestic and global production volumes. Slightly less than 1,900 tons of copper were mined at Greens Creek Mine in 2024.

Natural graphite was not produced in the U.S. in 2023 or 2024 (USGS, 2024, 2025). In July 2023, the Graphite One project in Alaska was awarded a grant of $37.5 through the Inflation Reduction Act (USGS, 2024). Graphite Creek is considered one of the largest large-flake graphite deposits in the world and the largest deposit of its type in the country (Case et al., 2023). Five companies were exploring or developing graphite-mining projects in the U.S. during 2024: two in Alabama, one in Alaska, one in Montana, and one in New York (USGS, 2025).

Table 3 summarizes mineral production of the six metals mined in Alaska in 2023 and 2024. Domestic and global production of those metals, along with natural graphite, are included for comparison.

Table 3. Alaska metal production in 2023 and 2024 compared to U.S. and global production for those metals. Data from USGS (2025).

Alaska, U.S., and Global Mineral Production of Selected Metals and Materials						
Tons	2023			2024		
	Alaska	U.S.	World	Alaska	U.S.	World
Silver	557	1,124	28,109	515	1,213	27,558
Gold	24	187	3,582	26	176	3,638
Zinc	646,830	845,464	13,337,830	663,740	826,725	13,227,600
Lead	102,955	297,621	4,817,051	138,586	330,690	4,739,890
Copper	-	1,245,599	24,911,980	1,874	1,212,530	25,352,900
Germanium	*10*	*10*	NA	*10*	*10*	NA
Graphite	-	-	1,686,519	-	-	1,763,680
Note: One ton (2,000 pounds) = 29,166.7 troy ounces; NA – Not Available. Note: 2024 U.S. and worldwide production values are estimated.						

Using the 2024 production volumes provided by USGS (2025), Alaska is a significant national and global producer of certain metals and critical minerals. In 2024, Alaska produced more than 42 percent of the country's silver, 15 percent of the nation's gold, more than 80 percent of the nation's zinc, almost 42 percent of the nation's lead, and 0.15 percent of the copper produced in the U.S. Alaska's contribution to global volumes of these metals includes 1.9 percent silver, 0.73 percent gold, five percent zinc, 2.9 percent lead, and insignificant copper.

Current Alaska Mineral Production

Final 2025 production values were not available at the time of this report, but production volumes are expected to be roughly similar to those cited for 2023 and 2024 in Table 3. Table 4 lists the estimated mineral production for Alaska in 2025. Final production volumes and values won't be available until the first quarter of 2026.

Volumes provided in the table are a mix of actual production through the first half of calendar year 2025 and production guidance provided by the mining companies for the remainder of the year.

Table 4. Estimated Alaska mineral production for 2025.

2025 Alaska Mineral Production (Estimated)	
Zinc (Zn)	560,000 – 575,000 tons
Lead (Pb)	105,000 – 136,000 tons
Gold (Au)	925,000 – 955,000 troy ounces
Silver (Ag)	13 – 15 million troy ounces
Copper (Cu)	1,500 – 2,000 tons
Germanium (Ge)	10 tons (estimated, not reported)
Coal	1,000,000 tons
Industrial Minerals	750,000 tons rock, 6.5 million tons sand and gravel

In 2025, Alaska had seven large operating mines, one small hard rock producer, hundreds of placer gold operations, and approximately 100 sand, gravel, and rock producers. Alaska's large mines continue to be important producers of gold, zinc, lead, silver, germanium, and copper. There was no reportable critical mineral production from any Alaska placer operations in 2025, but some operations may have produced minor amounts of silver, platinum, and other critical minerals. The locations of Alaska's lode mines and projected 2025 mineral production are shown in Figure 8.

Red Dog Mine is the largest zinc producer in the U.S. and one of the largest zinc producers in the world. It is also one of the largest silver producers in the U.S. and the only U.S. producer of germanium (USGS, 2025). All commodities produced at Red Dog Mine are considered critical minerals under the 2025 U.S. List of Critical Minerals. Red Dog Mine could be the largest critical mineral producer in the country.

Potential Future Alaska Critical Mineral Production

In 2024, the value of domestic primary mine production of critical minerals was $3.3 billion. At least 12 individual mineral commodities and the rare-earths group of minerals (without specification of the specific lanthanides) had primary production in the U.S. Zinc, mostly from Red Dog Mine with significant contribution from Greens Creek Mine, contributed the most to the total value of critical-mineral production (70 percent), followed by palladium and rare-earth elements (eight percent each).

For most critical minerals, the U.S. has been heavily reliant on foreign sources for its consumption requirements (USGS, 2025). Finding, developing, and producing critical minerals domestically has been a goal of the U.S. government to reduce national security vulnerabilities.

Alaska's future mineral production potential impact on the U.S. minerals import reliance is shown in Figure 9. Alaska is currently a significant producer of critical minerals, and past producing ore deposits may have resources that could be developed and mined in the future. The current mines will continue to produce these critical minerals based on mineral reserves and projected rates of production, assuming favorable economic conditions, stable permitting and taxation, etc. See subsequent section CURRENT AND PROJECTED PRODUCTION OF CRITICAL MINERALS IN ALASKA IN THE NEXT THREE, FIVE, AND 10 YEARS for additional information.

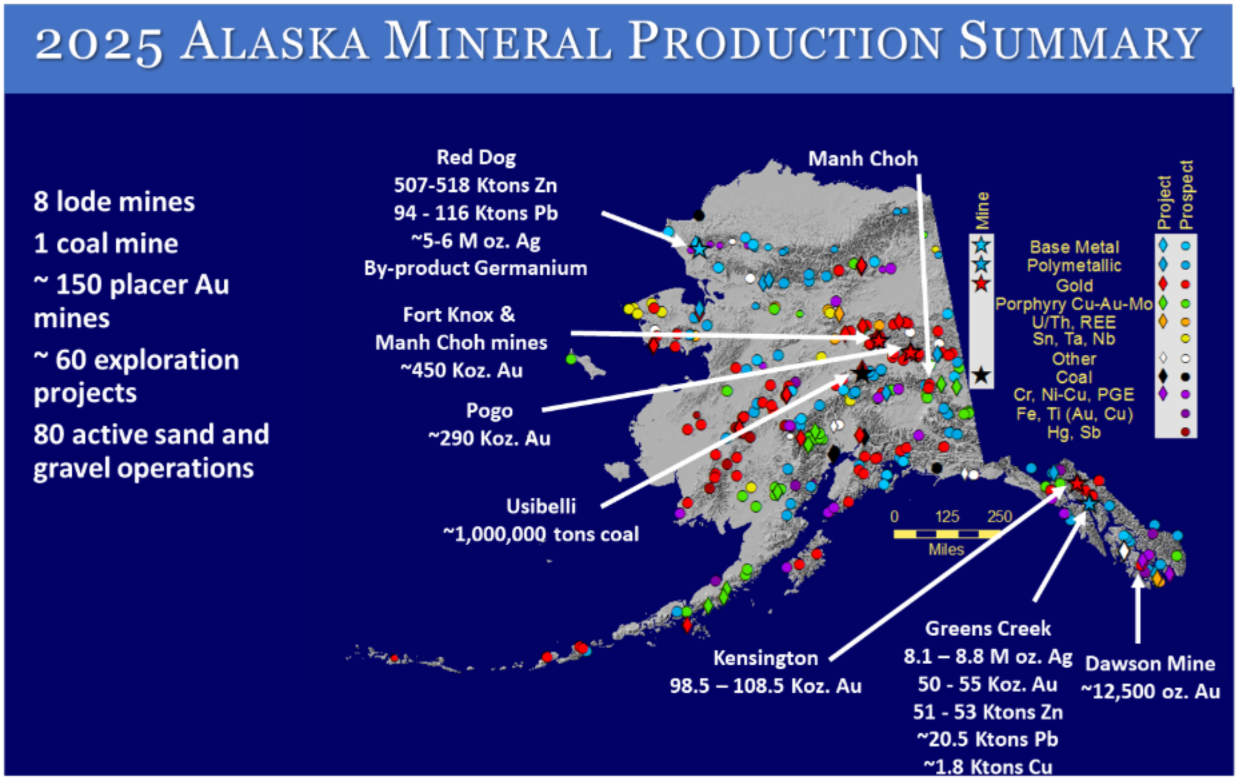

Figure 8. Location of Alaska large lode mines and projected production volumes of critical minerals and other commodities for each operation. Background image has colored dots representing selected significant mineral occurrences.

Alaska has the potential to produce even more critical minerals in the future based on the current understanding of mineral occurrences and mineral deposits throughout the state. Of the 60 critical minerals on the 2025 U.S. List of Critical Minerals, 57 out of 60 have a possibility of being produced in Alaska. Critical minerals that have not been located in appreciable amounts in Alaska are aluminum, potash, and silicon. Mineral exploration by the private sector and mineral-related studies by the public sector will continue to add to the knowledge base. Alaska's defined critical minerals resources and reserves should continue to grow.

Potential production is determined by many factors besides the occurrence of minerals. Whether a mineral deposit can be mined depends on a combination of geological, economic, technical, environmental, and social factors. Geologically, the deposit must have sufficient size, grade, and accessibility to make extraction feasible. Economically, the value of minerals must outweigh the costs of exploration, development, extraction, processing, and transportation, which are influenced by market prices and demand. Technically, mining methods and available technology must allow safe and efficient recovery of the resource. Environmental considerations include potential impacts on ecosystems, water, and air quality, as well as compliance with regulations. Finally, social and legal factors, such as land ownership, permitting, community acceptance, and political stability, play a critical role in determining whether mining can proceed.

As can be seen in Figure 10, Alaska's current large mines and advanced mineral exploration projects are spread across the state. Most of these mineral deposits have associated critical minerals, as illustrated in the red font. Although the existence of critical minerals in these deposits is likely or known, there remains considerable uncertainty as to the level of concentration of these associated critical minerals, or whether these critical minerals can be extracted from the ore.

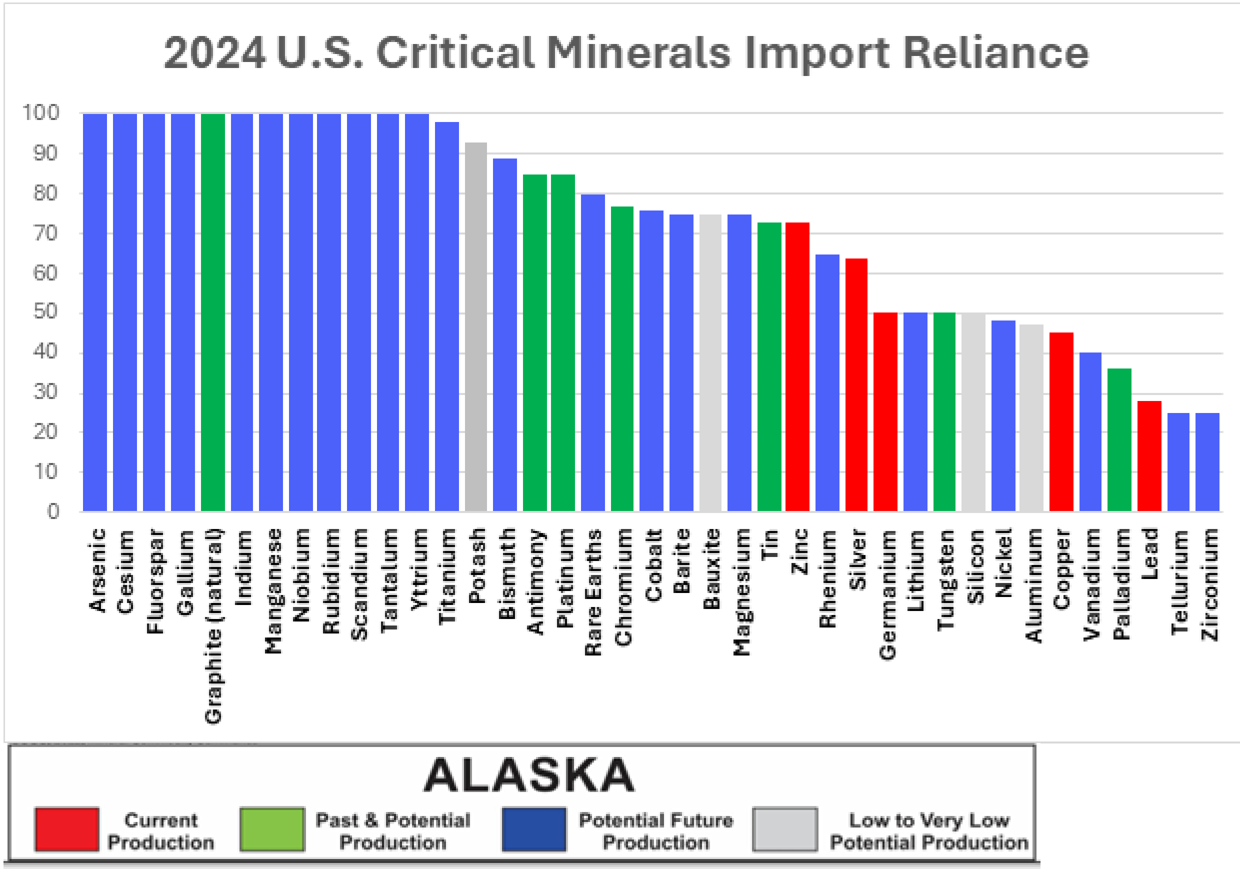

Figure 9. Alaska's current, past, and potential future production of critical minerals that are currently imported in the U.S.

Operating mines like Red Dog Mine, Greens Creek Mine, and Usibelli Coal Mine are strong candidates for near-term critical mineral production. These mines have supporting infrastructure in place and can integrate waste stream recovery for critical mineral extraction, minimizing costs and accelerating resource availability. Waste stream recovery of critical minerals from these mines is being investigated as part of the DOE-funded CORE-CM initiative in Alaska (Sheets et al., 2024).

For example, Greens Creek Mine estimates the total mass (in pounds) of zinc, vanadium, and chromium to be 288 million, four million, and 2.9 million, respectively, with the zinc alone valued at $395 million (Sheets et al., 2024). Though many of the critical minerals may not hold much value, it is possible they could be recovered if the tailings are mined as the precious metals and base metals in the tailings have been valued at $2.8 billion (Sheets et al., 2024).

Alaska is often described as a "warehouse of minerals" because it hosts an extraordinary diversity and abundance of mineral resources, including traditional commodities like gold, copper, zinc, and silver, as well as critical minerals essential for modern technologies such as graphite, rare earth elements, tin, tungsten, and platinum-group elements (Jones, 2022; Karl et al., 2016). The state's vast and largely undeveloped land, covering more than 663,000 square miles, contains numerous world-class deposits and active mines, such as Red Dog Mine (zinc and lead), Fort Knox Mine (gold), and Greens Creek Mine (silver, zinc, lead, gold), along with advanced exploration projects targeting copper, molybdenum, and rare earths. Many areas remain underexplored.

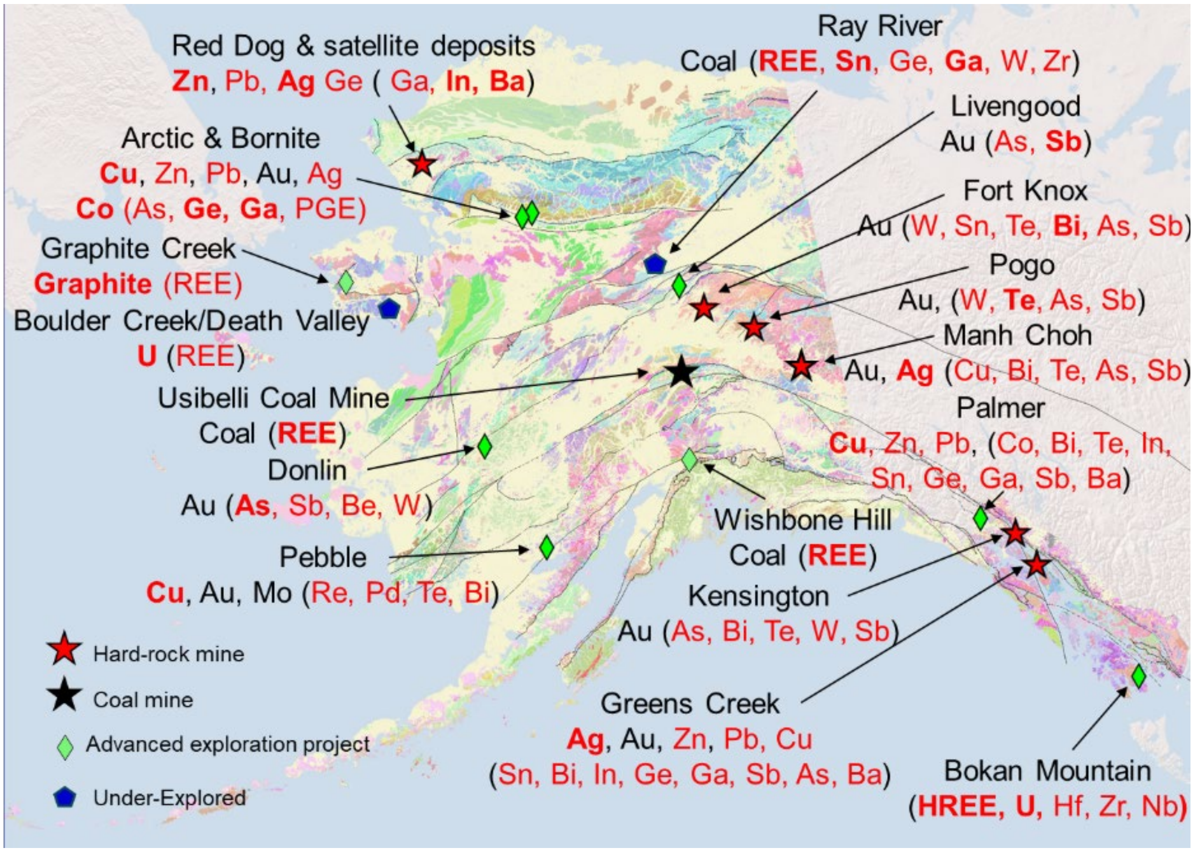

Figure 10. Alaska's current hard rock (lode) mines and advanced mineral exploration projects. Property names are listed with principal economic commodities. Critical minerals that are associated with the ore deposits are contained in paratheses. Critical minerals are colored red, and the most abundant critical minerals in **bold**.

Appendix B contains a list of all published mineral reserves and resources for Alaskan mining projects. Most of the listed mineral reserves and resources are made using globally recognized standards, but the table does include some historical reserves and estimates.

Table 5 is a summary of the mineral reserves and resources found in Appendix B. Most of the listed minerals are on the 2025 U.S. List of Critical Minerals. These mineral resources point to the potential for future mining. In most cases, much more work is needed to prove that these mineral resources could be extracted profitably under current conditions and regulations.

The mineral resources for Alaska listed in Table 5 were compared to world resources published by USGS (2024). This comparison is considered qualitative because the datasets used different criteria and the USGS data were not as current as the Alaskan data. However, the comparison illustrates the relative importance of Alaska's known mineral endowment from a global perspective. Also, not all minerals were used in this comparison due to a lack of data, time, and other factors.

Qualitatively, Alaska's critical mineral resources are quite significant. Alaska contains approximately seven percent of the global zinc resources, seven percent of the global silver resources, almost 2 percent of the world's lead resources, and more than 12 percent of the global copper resources. Other, non-critical mineral resources include seven percent of the global gold resources, 16 percent of the world's molybdenum resources, and 17 percent of the global coal resources. A quantitative estimate of mineral production from these resources would be highly speculative due to the wide range of variables affecting the development of new mines.

Table 5. Published mineral resources for Alaska ore deposits. Individual property data is found in Appendix B and compiled from company reports.

Alaska's 2025 Mineral Resources		
Metal or Commodity	**Tons**	**Troy Ounces**
Barite	23,247,270	
Chromite	1,938	
Cobalt	661,500	
Copper	47,145,510	
Gold		208,371,957
Graphite	22,136,078	
Lead	8,020,905	
Molybdenum	4,189,913	
Nickel	6,223,500	
Palladium		7,889,000
Platinum		4,295,000
Rare earth elements	38,752	
Rhenium	3,168	
Silver		1,238,062,799
Zinc	28,289,655	

COMPARING ALASKA'S MINERAL EXPLORATION INCENTIVES WITH SELECTED U.S., CANADIAN, AND AUSTRALIAN JURISDICTIONS

Mineral exploration is a critical component of national strategies for economic growth, energy transition, and technological advancement. Mineral exploration is inherently high-risk and capital-intensive, particularly in frontier regions characterized by remoteness, limited infrastructure, and challenging climates (Singer and Kouda, 1999). Public policy can affect exploration investment decisions through tax and royalty structures, direct subsidies and credits, public geoscience, and permitting regimes (Mining World, 2024; Castillo, 2020). Governments worldwide offer a range of incentives to attract investment, de-risk exploration activities, and secure supply chains for strategic minerals.

Alaska is endowed with world-class mineral resources but faces high costs and logistical challenges. Alaska is a major U.S. mining jurisdiction with significant production of zinc, gold, coal, and other commodities, and considerable potential in critical minerals (Szumigala, 2024; USGS, 2025). However, the state competes for exploration capital against other U.S. states, Canadian jurisdictions, and leading mining regions in Australia that offer more aggressive fiscal incentives and/or lower operating costs.

Alaska's mineral exploration incentives will be compared with those in Nevada, Arizona, Wyoming, Minnesota, Idaho, and Utah, and with major mineral-producing Canadian provinces and territories, including Quebec, Ontario, British Columbia, Yukon, and Nunavut, as well as with Australia (with reference to prominent mining states such as Western Australia and Queensland). The objective is to assess Alaska's relative attractiveness for exploration investment and to identify policy options that could enhance its competitive position without undermining public revenues or environmental safeguards.

Methodology and Jurisdiction Selection

The comparison focuses on four broad categories of exploration-relevant incentives, with several key incentives under each category:

1. **Fiscal incentives**
    - Tax credits and deductions specific to exploration
    - Royalty regimes and production-stage incentives that affect expected after-tax returns
    - Federal–state or federal–provincial/territorial interactions
2. **Public geoscience and data**
    - Geological mapping
    - Airborne geophysical surveys
    - Geochemical surveys and mineral potential assessments
3. **Infrastructure and risk-sharing mechanisms**
    - Direct financing of roads, ports, and power
    - Cost sharing programs or grants for early-stage exploration
4. **Permitting, land access, and institutional frameworks**
    - Clarity and predictability of land tenure
    - Coordination and predictability of environmental and land use permitting
    - Indigenous rights, land claims, and benefit sharing frameworks (at a high level)

Jurisdictions were selected for comparability and benchmark roles. A number of western U.S. states were selected due to their exploration potential, availability of public lands for mineral development, and perceived investment attractiveness. Nevada, Arizona, Utah, Idaho, and Wyoming are large western states with long histories of mining and continued mineral exploration for a wide variety of metals and critical minerals. Minnesota was included in the study because it is an important producer of iron ore and base metals and has a distinct leasing and royalty system.

Canada is a direct competitor with Alaska for mineral exploration dollars. Canadian investors and the Canadian mineral exploration industry are also a long-time source of exploration capital spurring mineral resource exploration and development in Alaska. Quebec, Ontario, and British Columbia are large, mature mining provinces with strong incentive regimes. Yukon and Nunavut are northern territories broadly comparable to Alaska in remoteness and climate.

Australia is one of the world's most competitive mining environments. Recently Alaska has received more exploration capital from Australian sources, with Australian mining companies competing strongly in the Alaska exploration market. Australian states like Western Australia and Queensland provide examples of Australian national and state exploration incentives.

The following analysis is primarily qualitative and descriptive. Published reports, statutory frameworks, and geological survey outputs are used to illustrate how specific instruments function. Investment climate rankings and proprietary fiscal modeling are not used. Instead, the emphasis is on the design and relative generosity of publicly documented programs.

U.S. Federal Policy

The U.S. federal government has significantly increased investment in critical minerals to reduce reliance on foreign sources, especially China. Investments are aimed at building a resilient domestic supply chain for defense and energy applications, and to support advanced manufacturing for electric vehicles, renewable energy systems, and military technologies. Some examples of programs or investments that benefit critical mineral exploration or development are given below.

Earth Mapping Resources Initiative (Earth MRI)

Earth MRI is a USGS program launched in 2019 to modernize geologic mapping of the nation's surface and subsurface (Day, 2020; Rowan, 2025). Its primary goal is to collect and integrate geologic, geophysical, geochemical, and topographic data to improve the three-dimensional understanding of U.S. geology and identify areas with potential critical mineral resources.

Earth MRI operates as a partnership among USGS, state geological surveys, federal agencies, tribes, universities, and private industry. The program uses advanced technologies such as airborne geophysical surveys, lidar, hyperspectral imaging, and detailed geologic mapping. In addition to mineral resource assessment, Earth MRI data support decisions related to energy resources, groundwater availability, natural hazards, and mine waste characterization.

The Infrastructure Investment and Jobs Act (IIJA) of 2021 authorized $510.7 million for USGS, with $320 million of these funds dedicated to Earth MRI to accelerate geologic mapping and resource assessments. Earth MRI has a mandate to complete an initial comprehensive national modern surface and subsurface mapping effort by 2031 (Day, 2020). IIJA also funded research facilities, rare earth element demonstration projects, and recycling strategies for critical minerals.

In 2025, Earth MRI offered $5 million in cooperative agreements to support mine waste characterization and geophysical surveys across multiple states (USGS, 2025e). Earth MRI data products are publicly available through USGS online portals and are critical for resource management, land-use planning, and mitigating natural hazards.

Alaska benefits substantially from the Earth MRI program. Earth MRI funds new geologic mapping, geophysical surveys, and geochemical sampling to identify critical mineral potential (Day, 2019; Kreiner and Jones, 2020; Kreiner et al., 2022). Many Earth MRI projects are in Alaska because of the state's large, underexplored regions and diverse mineral endowment. These federal datasets complement Alaska Division of Geological & Geophysical Surveys (DGGS) work and enhance the state's attractiveness for exploration, particularly for critical minerals. Earth MRI currently benefits from expanded funding through IIJA. Alaska has received $21 million in federal funds through the program since 2019, and in 2024 received $5.2 million (DGGS Staff, 2025). Similar funding is expected in late 2025.

Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Initiative

The Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Initiative, managed by DOE's National Energy Technology Laboratory (NETL), is a multi-year program to catalyze regional economic growth by establishing domestic supply chains for critical minerals, including rare earth elements, from unconventional and secondary resources (DOE, 2025f). The program focuses on eight U.S. regions to realize the full economic potential of basinal feedstocks—including coal, coal byproducts, acid mine drainage, and oilfield brines—for both mineral extraction and the manufacturing of high-value, non-fuel carbon products. By 2025, the initiative expanded in scope to include large-scale regional consortia and Technology Innovation Centers aimed at accelerating the commercial deployment of separation and purification technologies while fostering a Science-Technology-Engineering-Mathematics -capable workforce.

On January 6, 2025, DOE's Office of Fossil Energy and Carbon Management announced $45 million in federal funding for six projects to create regional consortia to accelerate the development of critical mineral and materials supply chains including novel nonfuel carbon-based products from secondary and unconventional feedstocks (DOE, 2025d). The University of Alaska Fairbanks (UAF) was awarded $7.5 million, with $1.875 million in matching funds from the Legislature for a total project value of $9.375 million (DOE, 2025e). UAF will work with three state geological surveys from Alaska, Oregon, and Washington to better understand the geologic framework and distribution of underexplored mineral resource deposits in the northwestern U.S. The partners will perform new data collection and analysis, geologic and mineral systems mapping, sample collection, and characterization (e.g., geochemistry, mineralogy, geochronology) to better understand the geologic framework and critical minerals and materials distribution and associations.

UAF's Institute of Northern Engineering previously participated in Phase One of the CORE-CM program. The Phase One program lasted from September 2021 to September 2024 with $1.5 million in DOE funding and $376,000 in cost-share funding from the Legislature. UAF and DGGS, with industry support, conducted a set of broad basinal assessments of critical minerals in Alaska (Sheets et al., 2024). The project's report includes actionable insights to support Alaska's critical role in securing domestic supplies of essential minerals while addressing economic, environmental, and technological challenges.

Section 45X Advanced Manufacturing Production Credit (45X Credit)

Part of the Inflation Reduction Act, the 45X federal income tax credit now covers extraction and processing costs for critical minerals. It is transferable and does not phase out for critical minerals, making it a long-term incentive for domestic production (Farrell, 2024). While this credit does not apply to exploration, it may serve as a catalyst to exploration.

Fixing America's Surface Transportation Act, Title 41 (FAST-41)

Title 41 of the Fixing America's Surface Transportation Act (FAST-41) is a voluntary federal program administered by the Federal Permitting Improvement Steering Council (Permitting Council) to improve transparency and predictability for environmental reviews of large infrastructure projects (Permitting Council, 2024). The council coordinates with 13 federal agencies to set and publicly track permitting timetables on the Federal Permitting Dashboard. FAST-41 aims to reduce administrative delays through early interagency consultation and standardized schedules, without altering existing environmental laws.

Projects on the FAST-41 dashboard can be either covered or transparency projects. The key difference in these designations is the level of intervention. Covered projects have full Permitting Council management, while transparency projects are publicly tracked for oversight (Permitting Council, 2025). A covered project is an economically significant infrastructure project subject to the National Environmental Policy Act (NEPA) with total investment of more than $200 million per project. FAST-41 defines a covered project as "any activity in the United States that requires authorization or environmental review by a federal agency involving construction of infrastructure for renewable or conventional energy production, electricity transmission, surface transportation, aviation, ports and waterways, water resources projects, broadband, pipelines, or manufacturing."

A transparency project is not a FAST-41 covered project, but rather a project that the Permitting Council Office of the Executive Director directs the lead agency to post to the Federal Permitting Dashboard for transparency purposes. These projects receive the transparency that is at the core of the FAST-41 process but do not receive the other benefits of FAST-41 coverage, including the development of a coordinated project plan and dedicated project management by Permitting Council experts (Permitting Council, 2025).

Department of Energy Initiatives

DOE has several major initiatives to secure critical minerals for energy, manufacturing, and national security. Part of the Energy Act of 2020, the Critical Minerals and Materials Program focuses on domestic production and processing of critical minerals (DOE, 2025g). It also promotes reuse, recycling, and alternative materials to reduce supply chain risks. The program includes the Critical Materials Innovation Hub led by Ames National Laboratory, which develops solutions across the materials life cycle.

Table 6. Alaska mining projects in FAST-41. Other Alaskan mining projects have stated that they have, or are planning to, apply for listing on FAST-41.

FAST-41 Mining Projects in Alaska (Covered & Transparency)			
Contango Ore Johnson Tract Critical Metals Project	Department of the Army, US Army Corps of Engineers - Regulatory	Covered	Planned
Donlin Gold Project	Department of the Army, US Army Corps of Engineers - Regulatory	Covered	Planned
Graphite Creek Project	Department of the Army, US Army Corps of Engineers - Regulatory	Covered	In Progress
Aqqaluk Pit Exploration and Expansion	Department of the Army, US Army Corps of Engineers - Regulatory	Transparency	Complete
Greens Creek Surface Exploration	Department of Agriculture, US Forest Service	Transparency	In Progress
Nikolai Nickel Project	Department of the Army, US Army Corps of Engineers - Regulatory	Transparency	In Progress

In 2025, DOE launched funding programs totaling nearly $1 billion for domestic production, processing, and recycling of critical minerals, including battery materials and rare earth elements, under IIJA provisions (DOE, 2025; McDonald et al., 2025).Open funding opportunities include piloting by-product critical minerals and materials recovery at domestic industrial facilities, a rare-earth-element demonstration facility, and Office of Science Financial Assistance Program.

Department of Defense Financing

The Department of Defense (DOD) uses multiple tools to secure critical mineral supply chains. Recent examples are summarized below.

The Defense Production Act (DPA) Title III authorizes loans, loan guarantees, and purchase agreements to expand domestic production of critical materials. Recent presidential determinations applied DPA Title III to rare earth elements and battery materials (DOD, 2022; de Naoum, 2025). DOD awarded $5.1 million under DPA Title III to REE cycle for recovering rare earth elements from electronic waste, supporting magnet supply chains for defense systems (DOD, 2025b).

Under the DPA, Alaska Range Resources received $43.4 million in late 2025 to extract, concentrate, and refine stibnite to produce military grade antimony trisulfide as part of the Estelle project (DOW, 2025). Alaska Range Resources plans to use the award to complete environmental studies, permitting, geological surveys, and testing to optimize and target drilling activities; initiate stibnite extraction; conclude a metallurgical study; and construct and commission a concentration plant and a refinery (Nova Minerals Ltd., 2025).

DOD created the Office of Strategic Capital to provide loans and equity investments. In 2025, the office issued its first $150 million loan to MP Materials for heavy rare earth separation capacity at Mountain Pass, California. The Office of Strategic Capital has $500 million in credit subsidy funding enabling up to $100 billion in loan authority for critical minerals projects (DOD, 2025).

DOD has also made equity investments in strategic mineral companies. The department invested $400 million in MP Materials, acquiring preferred stock and warrants, making DOD a major shareholder. This partnership supports magnet manufacturing expansion and rare earth processing (Urecki, 2025).

Through the Office of Strategic Capital and the Office of the Undersecretary of Defense for Acquisitions and Sustainment, DOD entered into a binding letter of intent with Trilogy Metals Inc., South32 Ltd., and Ambler Metals LLC for a $35.7 million investment to advance exploration and development of the Upper Kobuk Mineral Projects (including Bornite and Arctic) (Trilogy Metals Inc., 2025). The parties are committed to work collaboratively to include future permit applications in FAST-41.

The One Big Beautiful Bill Act (2025) appropriated $2 billion to expand the National Defense Stockpile and $5 billion to the Industrial Base Fund for critical mineral supply chains. An additional $1 billion was allocated for DPA financing through 2027 (Carl-Yoder et al., 2025).

Alaska's Mineral Exploration Incentive Framework

Fiscal and Royalty Regime

Mineral exploration and mining on state land in Alaska are governed principally by Alaska Statutes (AS) Title 38, Public Land, and Title 43, Revenue and Taxation. State mineral rights are managed by the Alaska Department of Natural Resources (DNR), with mining claim and lease provisions set out in AS 38.05.185–38.05.275 (Legislature, 2024). The fiscal framework relevant to exploration includes:

- **State mining license tax (AS 43.65)**
  Alaska levies a net income-based mining license tax on persons engaged in the business of mining. Net income for this tax is generally determined after deducting ordinary and necessary expenses, including exploration and development costs (Legislature, 2024b). Loss carryforwards allow early-stage expenditures to offset later income once production begins.
- **Corporate income tax (AS 43.20)**
  Corporations are subject to state corporate income tax on net income apportioned to Alaska. Entities taxable as a corporation under the U.S. Internal Revenue Code, generally C Corporations, may be required to make payment of corporate income tax to the State of Alaska (Alaska Department of Revenue, 2024). Exploration expenditures are deductible as business expenses or capitalized and depreciated, depending on their nature.
- **Royalties and rents on state lands (AS 38.05)**
  For state mining leases, Alaska typically charges royalties on mining production (often structured similarly to a net smelter return or net profits interest for large projects) and annual rents. Annual rent is paid to maintain the lease regardless of production status. For exploration projects, royalties only become relevant at production. Rent and minimum work requirements create incentives to conduct exploration to maintain tenure but are not in themselves fiscal subsidies.
- **Exploration incentive credit (AS 27.30)**
  Alaska's exploration incentive credit allows companies to claim up to 50 percent of qualified exploration expenditures as credits against future state mining license tax (MLT), corporate income tax (CIT), and production royalties. Eligible activities include geochemical surveys, drilling, trenching, and bulk sampling. The maximum credit is $20 million per project, valid for 15 years, and transferable upon property ownership change (DNR, 2021).

From an exploration investor perspective, Alaska's fiscal regime provides back-end fiscal relief with deductibility of exploration expenditures against future mining license and corporate income tax. But Alaska does not have a dedicated front-end exploration tax credit or flow-through mechanism equivalent to those in Canada. Exploration investment relief is thus realized only after a project becomes profitable, which is often many years after the original exploration outlays, if at all.

Public Geoscience and Data

Alaska has invested heavily in public geoscience, primarily through DGGS, which collaborates with USGS and other partners to conduct high-resolution airborne geophysical surveys, detailed geologic mapping, geochemical sampling and mineral resource assessments.

Examples include extensive airborne magnetic and electromagnetic survey coverage in the eastern Interior, the Alaska Range, and other mineral belts (DGGS, 2025b). These datasets substantially reduce geological uncertainty and exploration cost by providing baseline information that would be prohibitively expensive for individual companies to collect, especially in early-stage frontier areas.

DGGS conducts geological mapping and geochemical and geophysical surveys to attract mineral exploration investment and support responsible development of Alaska's mineral resources. These datasets have been an important component of many successful resource exploration programs, contributing to the private sector discovery of more than 22 million ounces of gold in the Salcha River–Pogo and Livengood areas since 2004 (DGGS Staff, 2025).

The Alaska Geologic Materials Center (GMC), operated by DGGS, hosts an archive of geologic data with an estimated replacement value of $35 billion (DGGS Staff, 2025). The 90,000 square -foot repository holds 782,000 public inventory items, including 22,000 mineral-related core holes totaling 766,000 feet and 617,000 representative feet of mineral core and cuttings (DGGS, 2025). These holdings are a tremendous resource for the exploration community.

Alaska's public geoscience programs act as an economic development engine, leveraging relatively modest public expenditures to catalyze private exploration investment (Alaska Minerals Commission, 2025). In terms of scale and ambition, Alaska's public geoscience effort compares favorably with many U.S. states and several Canadian jurisdictions.

Infrastructure Support and Risk Sharing

AIDEA is a state-owned development finance corporation that has played a prominent role in mining-related infrastructure, including:

- **DeLong Mountain Transportation System (DMTS)**
  AIDEA financed and owns the road and port serving the Red Dog zinc–lead mine, operated under commercial agreements with the mine operator (AIDEA, 2023).
- **Ambler Access Project**
  A proposed AIDEA-led industrial access road to the Ambler mining district, intended to facilitate exploration and future development of copper and polymetallic deposits. The project is under federal review (AIDEA, 2025).
- **West Susitna Access Project**
  A proposed AIDEA-led access road to access public lands to the west of the Little Susitna and Susitna rivers. The project is intended to facilitate exploration and future development of copper, gold, silver, antimony, polymetallic, and coal deposits, with more than 3,000 active mining claims in the region (Ruaro, 2024).

Although these projects are not exploration tax credits per se, they can significantly reduce the effective cost and risk of exploration in affected regions by improving logistics and signaling state commitment to resource development.

Permitting, Land Access, and Institutions

On state land, early-stage exploration typically involves location and recording of mining claims, payment of annual rents and compliance with minimum labor or work requirements and filing of exploration permits as needed (e.g., for surface disturbance, water use).

For advanced projects, Alaska uses a coordinated permitting process via the Large Mine Permitting Team within DNR's Office of Project Management and Permitting (OPMP). Alaska offers a unique, voluntary model through OPMP multi-agency coordination, to support consistent, defensible, transparent, and timely permit decisions for exploration and development (OPMP, 2024). OPMP is a voluntary service and recovers costs for reimbursable services, per signed agreements with project proponents. Although OPMP is not strictly an incentive, its services are widely regarded by project proponents as a beneficial state contribution.

All FAST-41 Mining Projects in Alaska (Covered and Transparency) have opted into coordination through OPMP. The state, through OPMP, permitted 2 new operating mines (Gil and Manh Choh) in less than 3 months (2021) and less than 6 months (2022), respectively (on an individual state authorization basis from the time complete applications were received to final decisions. These timelines represent the state's timelines and do not include federal NEPA review timelines.

Alaska's land tenure and Indigenous rights context is shaped by the Alaska Native Claims Settlement Act of 1971, which created Alaska Native corporations that own substantial surface and subsurface estates. Exploration on Alaska Native corporation lands is generally conducted under commercial agreements (Alaska Resource Development Council, 2024). This structure differs from Canadian treaty and modern land claims frameworks, but, as in Canada, Indigenous consent and benefit sharing are increasingly central to exploration risk management.

Comparison With Selected U.S. States

Nevada

Nevada is often considered the premier U.S. jurisdiction for gold mining investment. Nevada regularly ranks near the top in the annual Fraser Institute survey of mining companies for mineral potential and attractive policies (Mejia and Aliakbari, 2025). Its fiscal framework is anchored by the net proceeds of minerals tax, a state-level tax on the net proceeds of minerals, which allows deduction of exploration and development expenditures (Nevada Department of Taxation, 2025). Nevada does not impose a broad corporate income tax, versus most states, or like Alaska, with corporate income taxes for C Corporations.

For exploration, Nevada's incentives are conceptually similar to Alaska's with expenditures deductible against future taxable net proceeds, but there are no major front-end exploration credits. However, Nevada stands out for several reasons. It has long-established mining laws and extensive private/state mineral rights. Nevada offers one of the most efficient permitting environments in the U.S. (Patterson and Hayes, 2024). The Nevada Division of Environmental Protection, through its Bureau of Mining Regulation and Reclamation, oversees permitting for exploration, mining, and reclamation. The process is designed to protect water resources while ensuring timely permit issuance.

Nevada has mature permitting systems on private and state land, while federal land permitting remains comparable to Alaska in complexity. The Nevada Bureau of Mines and Geology (NBMG) has extensive public geoscience services, though airborne survey coverage has historically been less extensive at the frontier scale than Alaska's DGGS-led programs (Bhagwat, 2014).

From an exploration capital perspective, Nevada offers a low tax, stable regime but does not provide targeted exploration subsidies. Alaska is broadly similar in this respect, but with a higher general tax burden and more challenging operating conditions.

Arizona

Arizona is a major copper producer with growing interest in critical minerals. Mining laws and regulations are clearly defined (Arizona Geological Survey (AZGS), 2014). Its fiscal framework includes state and local taxes, including a severance-type tax on minerals and a broad-based transaction privilege tax. There is no specialized, largescale exploration tax credit program.

As in Alaska, exploration expenditures are generally deductible in computing taxable income, but the timing benefit is limited by the preproduction nature of exploration. Arizona's comparative advantages lie in an exceptional geological endowment in porphyry copper systems, established mining infrastructure and workforce, and relatively benign climate and logistics.

These factors reduce exploration costs even in the absence of targeted fiscal incentives. Relative to Alaska, Arizona's physical and infrastructure advantages compensate for a similar lack of front-end exploration credits.

Idaho

Idaho has a long history of hardrock mining including silver, base metals, phosphates, and more recently, cobalt and rare earth elements. The Idaho Department of Lands (IDL) administers state mineral leases and mineral exploration locations (IDL, 2019).

Idaho imposes both a one percent mine license tax on net profits from mining and a general corporate income tax. Exploration and development expenditures are generally deductible for income tax purposes. However, Idaho does not offer a dedicated front-end exploration credit.

The Idaho Geological Survey (IGS) conducts geologic mapping and mineral resource assessments, and it publishes data on historical and active mining districts (IGS, 2025). Recent work has emphasized critical minerals in central Idaho.

Relative to Alaska, Idaho offers lower logistical and climate-related costs for many projects, a broadly similar fiscal framework (back-end deductibility, no targeted front-end credit), and less extensive frontier airborne geophysics but good district-scale mapping.

Utah

Utah is a diversified mining state, producing copper, gold, molybdenum, potash, phosphate, and other commodities. The Utah School and Institutional Trust Lands Administration and Utah Division of Oil, Gas and Mining oversee state mineral leasing and regulation (Utah Division of Oil, Gas, and Mining, 2025; Utah Department of Natural Resources, 2023).

Utah applies ad valorem and severance-type taxes on mineral production, alongside corporate income tax. Exploration and development costs are deductible. Utah has historically emphasized a generally favorable tax environment and streamlined permitting over explicit exploration credits. However, in 2022 the Utah State Legislature passed Senate Bill (SB) 250, which created an exploration tax credit for certain non-coal minerals operations.

Utah provides a transferable mineral exploration tax credit designed to incentivize mining investment. Under SB250 (Utah State Legislature, 2022), taxpayers engaged in mining and subject to severance tax may claim a nonrefundable credit equal to certified mineral exploration expenditures, including costs for permits, labor, equipment, and consultants. The credit is capped at $20 million or 30 percent of severance tax liability per year, with unused amounts eligible for a 15-year carryforward. Importantly, the credit is transferable, allowing claimants to assign it to another party through written certification (Utah Office of Administrative Rules, 2025).

The Utah Geological Survey (USG) conducts geologic mapping, mineral resource assessments, and targeted studies of critical minerals in the Basin and Range, Colorado Plateau, and other regions. Most recent mapping and publications focus on geologic hazards. There is not a geophysical program focused on mineral resources.

Utah's mineral exploration tax credit is similar to Alaska's mineral exploration tax credit, as a back-end tax deduction program. Utah does not have any front-end exploration incentives. Utah has more accessible infrastructure. Utah has regionally targeted geoscience programs, but no mineral-focused geophysical programs.

Wyoming

Wyoming's economy is dominated by coal, uranium, trona, and hydrocarbons, but the state also has hardrock mineral potential (Wyoming State Geological Survey, 2024). Key features of Wyoming's mining laws include significant severance taxes and royalties on many commodities, no major exploration specific tax credits, and a generally favorable regulatory climate for extractive industries. Wyoming's mineral taxes vary by commodity (Wyoming Department of Revenue, 2024).

The Wyoming State Geological Survey (WSGS) provides public geoscience data, but the scale of hardrock mineral mapping is much more limited than in Alaska or some Canadian provinces (WSGS, 2024b). The WSGS has recently conducted airborne geophysical surveys with USGS as part of the Earth MRI program (Doom and Carter, 2025). For hardrock explorers, Wyoming offers fiscal stability and a supportive political climate. The state currently offers grant-based matching funds for mineral exploration administered through the Wyoming Energy Authority, but it lacks the exploration-focused incentives seen in Alaska or Canada.

Minnesota

Minnesota hosts significant iron ore (taconite) and nonferrous mineral potential in the Duluth Complex and other mineral belts. Mineral rights are a mix of state, federal, tribal, and private ownership, with the Minnesota Department of Natural Resources (MNDNR) managing state mineral leases (MNDNR, 2025).

Minnesota varies significantly from most western U.S. states because more than 70 percent of its lands are privately owned and only seven percent (3.8 million acres) are federally owned. The majority of MNDNR-administered lands, totaling 5.6 million acres, are in the remote northern part of the state dominated by wetlands.

Different mining laws in Minnesota apply to iron ore than to other metallic minerals. The state nonferrous metallic mineral leases contain conditions and obligations specifically designed to mitigate the environmental impacts of exploration and/or mining. Before mineral exploration occurs under a state nonferrous metallic mineral lease, an explorer (a state mineral lessee) must submit an exploration plan to MNDNR. After receipt of an exploration plan, the public is notified on the MNDNR website within five business days of the submittal. The state has up to 20 days to complete a review and determine whether changes or conditions are required.

The state leases mineral rights via competitive bid or negotiated leases and collects royalties based on production. Royalty rates and lease terms vary by commodity and lease type. If a state mineral lease terminates, the drill cores associated with that lease become state property and public data (MDNR, 2014).

Minnesota applies a production tax on taconite in lieu of traditional ad valorem property tax, and corporate income tax applies to mining companies. Minnesota imposes multiple taxes on companies engaged in nonferrous metal mining, including a gross proceeds tax, occupation tax, net proceeds tax (in certain areas), and ad valorem tax (Minnesota Department of Revenue, 2025). Exploration and development expenditures are generally deductible in computing taxable income. However, Minnesota does not provide an exploration tax credit, grants, or royalty reductions for mineral exploration.

The Minnesota Geological Survey (MGS) and MNDNR produce geologic maps, drillhole databases, and mineral potential assessments, particularly in northeastern Minnesota (MGS, 2025; MGS, 2025b). There is no dedicated geophysical program.

In summary, Minnesota has a mix of land ownership, but over 70 percent of the land is privately owned. Minnesota does not offer any front-end or back-end mineral exploration credits. Relative to Alaska, Minnesota has a limited, localized geoscience program without a regional geophysical program that supports mineral exploration. Minnesota benefits from excellent infrastructure and a long mining history in the Iron Range, reducing exploration costs compared with Alaska's remote belts.

Conclusions for U.S. Jurisdictions

While not all U.S. states offer direct mineral exploration incentives, many participate in federal programs or provide indirect support through permitting, infrastructure, or tax policy. States like Alaska, Nevada, and Utah lead in offering structured incentives, while other states greatest benefits are derived from federal partnerships such as Earth MRI and the 45X tax credit.

Comparison With Canadian Jurisdictions

Federal Canadian Framework: Strong Front-End Mineral Exploration Tax Incentives

Mining is an important component of Canada's economy, and accounts for approximately five percent of the country's GDP in 2024 (Natural Resources Canada, 2025). In 2024 mineral exports accounted for 21 percent of Canada's total domestic exports. Canada supports its mining industry with investment and incentives. Canada's most distinctive exploration incentives are the combination of a front-end mineral exploration tax credit and flow-through tax mechanism.

Canada's federal Flow-Through Share (FTS) is a tax mechanism that allows a mining company to "renounce" qualifying exploration expenditures to investors, who then deduct these expenses from their own income (Canada Revenue Agency, 2024, 2025). This effectively transfers tax deductions to investors, increasing the amount they are willing to pay for exploration equity. FTS is 15 percent for mineral exploration tax credits and 30 percent for flow-through critical mineral mining expenditures (Association for Mineral Exploration, 2025).

The Canadian government introduced the 30 percent Critical Mineral Exploration Tax Credit (CMETC) in 2022 as part of Canada's critical minerals strategy (Department of Finance Canada, 2025). The CMETC applies to exploration expenditures targeted at minerals used in the production of batteries and permanent magnets (both of which are used in zero-emission vehicles or are necessary in the production and processing of advanced materials), clean technology, or semi-conductors. The 30 percent CMETC cannot be claimed in addition to the 15 percent METC.

Eligible grassroots (initial) exploration expenses are classified as Canadian Exploration Expense (CEE) and are 100 percent deductible in the year incurred, either by the company or by investors through FTS (Canada Revenue Agency, 2024; Association for Mineral Exploration, 2025). CEEs are the costs incurred while determining the existence, location, extent, or quality of a mineral resource, petroleum, or natural gas in Canada. It is important that companies have a good understanding of the type of expenditures that qualify as CEEs, which may be renounced to flow-through shareholders and provide attractive tax credits to such shareholders.

Canada's federal Mineral Exploration Tax Credit (METC) provides a 15 percent non-refundable tax credit to investors in flow-through shares for eligible mineral exploration, commonly used in grassroots projects. Canada's federal METC was extended to March 31, 2027 (Department of Finance Canada, 2025).

Canadian Development Expenses (CDE) are the costs incurred for sinking or excavating a mine shaft, main haulage way, or similar underground work after a mine comes into production, developing a mine before production, or buying a Canadian mineral property (Natural Resources Canada, 2025b). CDEs can be deducted at a 30 percent declining balance. A company can carry unused balances forward indefinitely or transfer them to investors as flow-through shares (excluding the cost of a Canadian mineral property) (Natural Resources Canada, 2025).

Combined, these instruments significantly reduce the after-tax cost of exploration and improve access to capital, particularly for junior companies. No equivalent mechanisms exist at the U.S. federal level or in Alaska.

Quebec

Quebec is frequently cited as one of the most attractive jurisdictions for mining exploration, due in large part to its generous fiscal incentives (Government of Quebec, 2024). Quebec offers provincial refundable tax credits for mining exploration expenditures, with enhanced rates for remote or northern regions. These provincial credits can be stacked with federal FTS and CEE credits (Government of Quebec, 2022). The province also has a mining tax regime that taxes mining profit with allowances for depreciation and exploration expenditures.

In some cases, the combination of federal and provincial incentives can offset a substantial proportion of grassroots exploration costs, particularly for flow-through financed junior companies. Quebec also maintains a strong geological survey and digital geoscience portal, providing extensive public data.

Relative to Alaska, Quebec offers substantially more generous front-end fiscal incentives. The province has extensive infrastructure in southern and central parts of the province, though northern Quebec presents similar logistical challenges to Alaska. Quebec's public geoscience coverage in many regions is similar or better than Alaska's coverage.

Ontario

Ontario is a major mining jurisdiction with significant production of gold, base metals, and critical minerals. Its exploration incentives are similar to Quebec's front-loaded tax relief approach. The Ontario Focused Flow-Through Share Tax Credit (OFFTS) is a provincial tax credit for individuals who invest in flow-through shares of eligible mining companies with expenditures in Ontario (Government of Ontario, 2025; Government of Ontario, 2025b). Also, under both Canadian CEE/CDE rules and Ontario's mining tax regime, exploration and pre-production expenses can be deducted from taxable income or mining profits.

The Ontario Junior Exploration Program (OJEP) is an initiative of the Ontario government that helps attract investment in early exploration, expand the pipeline of mineral development projects (including critical minerals), and lead to more mines and jobs in Ontario (Ontario Ministry of Energy and Mines, 2025). To support grassroots mineral exploration, Ontario invested CDN$10 million in 2025 for one-year's funding in the OJEP. This includes CDN$4 million dedicated to the Critical Minerals Stream and CDN$500,000 for the new Prospectors Stream.

Prospectors can apply for up to CDN$50,000 per project in the New Prospectors Stream. Projects under the Prospectors Stream include any grassroots exploration work conducted by a licensed Ontario prospector. Grassroots mineral exploration involves the identification of new mineral exploration targets or the evaluation of existing targets in an area that is not known to host a mineral deposit with economic potential.

In OJEP, junior mining companies can access up to CDN$200,000 per mineral exploration project. Additionally, approved projects will be eligible for an extra CDN$15,000 to support Indigenous participation, on top of the existing funding (Ontario Ministry of Energy and Mines, 2025).

The Ontario Geological Survey (OGS) conducts regional mapping, airborne geophysics, and publishes annual summaries of field work and exploration trends (OGS, 2024). The OGS also operates Geoscience Laboratories, a full-service inorganic analytical facility that specializes in research grade analysis and provides services to government, academia, and private sectors.

Relative to Alaska, Ontario provides stronger front-loaded, direct tax incentives to exploration investors while also offering a mature infrastructure network and an established mining supply chain.

British Columbia

British Columbia combines a mining-friendly policy stance with explicit exploration tax credits. The British Columbia Mining Exploration Tax Credit (METC) is a provincial income tax credit equal to a percentage (commonly 20–30 percent depending on project location and policy changes) of eligible exploration expenditures incurred in British Columbia (Government of British Columbia, 2025). Enhanced rates may apply in specified remote or previously impacted areas. The METC credit is not eligible to be "flowed through" to investors, but it can be used in combination with federal flow-through shares and CEEs, further amplifying the incentive.

The British Columbia Geological Survey (BCGS) provides mapping, geophysical data, and annual synthesis of exploration and mining activity (Wallace et al., 2025; Clarke et al., 2025; BCGS, 2025).

British Columbia's combination of fiscal incentives, well developed infrastructure in many mining regions, and stable legal framework makes it a strong competitor for exploration capital. Compared with Alaska, British Columbia's advantage lies primarily in its substantial, refundable or non-refundable exploration tax credits and federal/provincial stacking of front-loaded tax credits.

Yukon

Yukon is directly comparable to Alaska in terms of latitude, remoteness, and climatic conditions. It has, however, adopted more aggressive direct mineral exploration support with front-loaded tax credits and grants.

The Yukon Mineral Exploration Program (YMEP) is a cost-shared grant program that provides funding to prospectors and companies for grassroots hard rock and placer exploration activities (geological mapping, geochemical sampling, geophysics, and sometimes drilling) (Government of Yukon, 2024, 2024b, 2024c). The program reimburses a portion of the risk capital required to explore (Government of Yukon, 2024). To be eligible for YMEP funding, exploration expenditures for the entire property/project must not exceed $300,000 in a given funding year. A maximum of $250,000 of cumulative funding can be assigned to one property over its lifetime, regardless of ownership of the property. YMEP grants complement federal flow-through shares and Canadian Exploration Expenses, substantially lowering private capital requirements for early-stage projects (Government of Yukon, 2024).

The Yukon Geological Survey (YGS) provides regional mapping, geophysical surveys, and extensive public data similar to products produced by Alaska's DGGS (YGS, 2025). The Yukon Geological Survey also collects information and maintains a database on mining activities completed in the territory (YGS, 2020). This dataset represents the geographical extents of the work performed in annual Yukon mining assessment reports. The assessment reports are submitted by the owners of mining claims and are technical reports outlining the work done on claims. This dataset is updated quarterly.

For small and medium sized exploration companies, Yukon's combination of direct grants and federal tax incentives creates a much more favorable front-end risk profile than Alaska. Alaska's public support is largely indirect (geoscience and infrastructure) rather than grant or credit based. However, Alaska's back-end tax credits are stronger than those in the Yukon.

Nunavut

Nunavut covers a vast, remote region with significant mineral potential in gold, iron, base metals, and diamonds. A significant portion of prospective land is Inuit-owned under modern land claims agreements, requiring commercial agreements with Inuit organizations. Its incentive framework features programs for prospectors and exploration companies. Projects in Nunavut benefit from federal Canadian FTS and CEEs. In some cases, federal programs provide additional support for northern or remote exploration.

The Nunavut Prospector's Program (NPP) supports Nunavut residents and prospectors (Government of Nunavut, 2025). Qualified prospectors may apply for up to $8,000 per year to cover basic expenses while exploring for new mineral occurrences in Nunavut. This financial support applies to project-related expenses such as fuel, vehicle maintenance, food allowance while in the field, assistant wages, prospecting supplies, and mineral assay costs.

The Nunavut Department of Economic Development and Transportation maintains the Nunavut Exploration Support Program Policy to encourage advancement of exploration projects in Nunavut through targeted financial assistance for work that builds Nunavut's geoscience information base regarding mineral deposits and increases community confidence in the mining sector (Government of Nunavut, 2024). The Nunavut Exploration Support Program Policy includes the Discover, Invest, Grow (DIG) Program and the Community Engagement Support Program.

DIG provides contributions to mineral exploration companies conducting activities which advance exploration work on a project in Nunavut (Government of Nunavut, 2024). Qualified exploration companies may apply for contributions per year to offset eligible costs associated with conducting mineral exploration activities in Nunavut. This financial support applies to direct costs associated with exploration drilling focused on testing new targets, expanding known prospects, contributing to resource conversion, and projects carrying out costs associated with bulk sampling (Government of Nunavut, 2025b). DIG will contribute up to 25 percent of eligible expenses up to an annual maximum of $250,000 per project application. Exploration companies with ongoing projects may apply in subsequent years, however no project may receive more than $500,000 in program assistance over the project lifespan (Government of Nunavut, 2025b).

The Nunavut government also offers a Community Engagement Support Program (CESP). Qualified community organizations, mineral exploration companies, and junior mining companies may apply for up to $100,000 per year to offset eligible costs associated with community engagement activities with respect to a proposed exploration project.

The Canada-Nunavut Geoscience Office (CNGO) is a partnership between federal and territorial governments and Inuit organizations that provides geoscience data, mapping, and annual summaries of exploration and mining activity (CNGO, 2025). Most of the geoscience related to mineral exploration appears to be conducted by the Geological Survey of Canada (GSC).

Relative to Alaska, Nunavut has similar logistical and climatic challenges but can provide more attractive exploration financing conditions through the federal Canadian system and several territorial programs. Alaska has a superior geoscience organization and data for mineral explorationists.

Comparison With Australia: A Global Benchmark for Stable, Data-Rich Regimes

Australia is among the world's leading mining jurisdictions, combining political stability, extensive public geoscience, and, in some cases, explicit exploration incentives. Australia is aggressively promoting exploration of lithium, cobalt, and rare earths to support its net-zero emissions goals and global competitiveness in clean energy supply chains. Australia has a national framework to accelerate exploration, extraction, and processing of critical minerals (Australia Department of Industry, Science, and Resources, 2025). The fiscal regime for mining and mineral exploration is shared between the Commonwealth (federal) government and the states/territories.

Commonwealth (Federal) Level

Australia levies corporate income tax and provides general deductions for exploration and development expenditures; certain incentives have targeted junior explorers or specific commodities through time-limited programs (Australian Government, 2023).

Australia's Junior Minerals Exploration Incentive (JMEI) is similar to Canada's flow-through shares. The JMEI is designed to boost greenfield (new area) mineral exploration by letting junior companies convert exploration losses into tax credits, which are then passed to new investors as refundable tax offsets or franking credits, making it easier to raise capital for high-risk discoveries. The incentive was introduced in 2017; between 2017 and 2024, AUD$182.2 million in credits were issued to exploration companies. This was estimated to stimulate a total of AUD$404 million (present value) of additional greenfield exploration activity that would not have occurred otherwise.

The Junior Minerals Exploration Incentive had a notable impact on Australian government revenue. The expected increase in revenue, which includes personal tax and company tax minus the tax forgone through the Junior Minerals Exploration Incentive tax offset, is estimated to be AUD$391 million in present value terms (Andrawes and Magnusson, 2025). The study found that the economic benefits extend beyond the mining sector, particularly in terms of GDP impact. The additional mining activity spurred by the incentive is expected to produce AUD$5.9 billion in minerals in present value terms (Andrawes and Magnusson, 2025; Douglas et al., 2024).

Australia's Critical Minerals Production Tax Incentive is designed to establish and expand critical minerals processing and refining in Australia (Australian Taxation Office, 2025). The Critical Minerals Production Tax Incentive is available from July 2027 to June 2040. The program allocates $7 billion over ten years to support 31 minerals identified on Australia's Critical Minerals List. It will provide a 10 percent tax offset on eligible Australian processing expenditures for critical minerals processed and refined during the period. The Critical Minerals Production Tax Incentive allows for up to 10 years per project. The offset is uncapped and refundable (Australian Taxation Office, 2025).

In 2021, Australia established the Critical Minerals Facility. The Critical Minerals Facility is a financial program managed by Export Finance Australia and provides financing to projects that are aligned with the Australian Government's Critical Minerals Strategy (Export Finance Australia, 2023). The facility was funded with AUD$2 billion to help projects suffering from gaps in private finance to overcome these gaps and get off the ground. The funding can come in the form of loans, loan guarantees, bonds, and working capital support and is intended as a complement to commercial financing.

Recent federal budgets committed over AUD$1.4 billion in direct financial support to critical mineral projects. Arafura Rare Earths received an AUD$840 million package of loans and grants for the development of the Nolans Project in Northern Territory (Australasian Institute of Mining and Metallurgy [AusIMM], 2024). In Queensland, Gladstone-based Alpha HPA received AUD $200 million to establish a high-purity alumina processing facility. Renascor Resources will receive up to $185 million in loans to expedite development of its Siviour Graphite Project in South Australia. Pilbara Minerals may receive up to AUD$200 million in loans to expand mining and processing operations at the Pilgangoora Project in Western Australia (Export Finance Australia, 2023).

Australia has invested heavily in precompetitive geoscience data. Geoscience Australia, the Australian equivalent of the USGS, provides regional-scale geologic mapping, high-resolution airborne geophysics, and deep crustal studies (Geoscience Australia, 2025; Pheeney et al., 2025). The Exploring for the Future program, led by Geoscience Australia, was a major government initiative (2016-2024) to map Australia's subsurface geology for critical minerals, energy (oil, gas, hydrogen), and water resources using advanced technology like seismic surveys, lightning sensors, and AI, especially in underexplored areas like northern Australia (Geoscience Australia, 2024).

Western Australia

Western Australia imposes royalties on mineral production and manages mineral rights and exploration licenses (Government of Western Australia. 2026). Exploration expenditures are typically deductible for state royalty and/or profit-based tax calculations in specific projects.

Western Australia's Exploration Incentive Scheme co-funds drilling and geoscientific surveys. The program co-funds up to 50 percent of drilling costs, prioritizing greenfield exploration and critical minerals. Applications undergo rigorous technical assessment, with projects evaluated based on geological merit, innovative exploration methodologies, and potential economic impact. This competitive selection process ensures funding flows to projects with the strongest scientific basis and potential for discovery. Recent funding rounds awarded AUD$7.28 million to 50 projects (Government of Western Australia, 2024).

Queensland

Queensland imposes royalties on mineral production and manages mineral rights and exploration licenses (Queensland Revenue Office, 2025; Australia Business Licence and Information Service, 2025). Exploration expenditures are typically deductible for state royalty and/or profit-based tax calculations in specific schemes.

Queensland offers the Collaborative Exploration Initiative (CEI). This initiative offers merit-based funding for industry to encourage investment in underexplored parts of Queensland and support for innovative exploration techniques and promotes the discovery of minerals for the future (Queensland Department of Resources, 2025).

In summary, relative to Alaska, Australia's strengths are an extremely comprehensive and integrated geoscience program with state and federal partnerships. Programs such as Exploring for the Future have generated new data in underexplored regions. This investment model is conceptually similar to Alaska's DGGS partnership with USGS but is larger in scope. Alaska is competitive with individual states but lags the national Australian system in sheer scale and integration.

Australia and Alaska have stable, well-known regulatory frameworks. Alaska lacks the public-private, co-funded exploration programs that several Australian states have to encourage mineral exploration.

Exploration Reporting

Canada and Australia both require comprehensive mandatory reporting about exploration activities. The reports are required for exploration projects held by Canadian and Australian registered companies.

Canada

National Instrument 43-101 (NI 43-101) Standards of Disclosure for Mineral Projects is a regulatory framework set by the Canadian Securities Administrators that governs how public companies must disclose scientific and technical information about mineral projects. This framework ensures that the information disclosed is accurate, credible, and understandable to investors, providing a standardized reporting mechanism for mineral exploration, development, and production activities (Rangefront Mining Services, 2024).

A NI 43-101 report must be prepared by a qualified person who is an engineer or geoscientist with at least five years of experience in mineral exploration, mining, or mineral project assessment and is a member in good standing of a professional association. The report covers several key components:

1. Executive Summary: Provides a brief overview of the project, including its location, ownership, geological setting, exploration history, mineral resource and reserve estimates, and conclusions and recommendations
2. Introduction: Details the purpose of the report, the terms of reference, and the sources of information and data
3. Property Description and Location: Includes detailed information about the property's location, area, mining rights, permits, and agreements
4. Accessibility, Climate, Local Resources, Infrastructure and Physiography: Describes the project's logistical aspects, including access to the site, climate, availability of water, power, labor, and potential environmental impacts
5. History: Outlines previous exploration, ownership, and production history
6. Geological Setting and Mineralization: Details the regional, local, and property geology and describes the mineralization
7. Exploration: Summarizes the exploration activities undertaken, including geophysical, geochemical, and geological surveys, and drilling
8. Drilling: Provides details on drilling programs, including techniques, depths, and significant results
9. Sample Preparation, Analyses, and Security: Describes the procedures for sample collection, preparation, analysis, and measures taken to ensure the security of the samples

10. Data Verification: Discusses the steps taken by the qualified person to verify the data, including personal inspections, data reconciliation, and independent sample analysis
11. Mineral Resource and Reserve Estimates: Includes detailed information on the methodology used for resource and reserve estimation, classification criteria, and the results
12. Other Relevant Data and Information: Any additional information that may impact the project's economic viability, such as environmental studies, agreements, or economic analysis
13. Interpretation and Conclusions: The qualified person's interpretation of the data and conclusions regarding the project's potential
14. Recommendations: Suggestions for further work, including proposed exploration or development programs and budgets
15. References: A list of all sources of information used in the report

A NI 43-101 report is required in several circumstances, primarily related to public disclosures by mineral exploration and mining companies listed on Canadian stock exchanges. Companies involved in mineral projects and making an initial public offering must prepare a NI 43-101 report. A NI 43-101 report is required when a company acquires or discovers a new mineral project that significantly affects the company's value or investment decisions. Form 43-101F1 technical documentation is required if a disclosure is deemed a material change for the company, like announcing mineral resources, reserves, or exploration results. An Annual Information Form typically mandates inclusion of NI 43-101 reports for each material project.

Australia

The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code) is a professional code of practice that sets minimum standards for public reporting of exploration results, mineral resources, and ore reserves (JORC, 2012, 2025). The JORC Code provides a mandatory system for the classification of these metrics according to the levels of confidence in geological knowledge and technical and economic considerations in public reports.

Mandatory Drill Core Submittal

Canada

Canadian provincial and territorial governments require companies to properly manage and, in some cases, submit mineral exploration drill core. The federal government does not directly mandate mineral exploration core submission but collaborates with provinces/territories to manage data and samples, which often end up in provincial core libraries. General guidelines are available from the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) (CIM, 2018).

The Canadian federal government, primarily through the GSC, focuses on national geoscience information and research, international trade, environmental protection, and data compilation. GSC maintains repositories for oil and gas well core/cuttings from the western provinces, Yukon, Northwest Territories, and East Coast offshore, but provincial bodies primarily handle mineral exploration core samples. The federal government leverages provincial data and collections for national initiatives, such as the Canadian Digital Core Library project, which uses AI analysis on historical core samples to spur new investment.

Provincial and Territorial requirements for the handling and storage of drill core are broadly similar across Canada. Each province or territory is re responsible for mining within their jurisdictions. In many cases, drill core must be stored in an orderly, weatherproof manner on or near the mineral claim as long as the claim is active. The storage areas must meet specific standards, such as being placed not less than 30 meters from any water body. In many cases, drill core must be stored in an orderly, weatherproof manner on or near the mineral claim as long as the claim is active. The storage areas must meet specific standards, such as being placed not less than 30 meters from any water body.

Many provinces operate core libraries where samples from exploration activities are collected, archived, and made available for future study by industry and academia. Examples include:

- Alberta: The Alberta Geological Survey maintains the Mineral Core Research Facility with extensive collections of mineral and coal core samples from government surveys and industry exploration.
- Nova Scotia: The province's core library holds over 650,000 meters of core from more than 7,500 drillholes for viewing and research.
- Manitoba: The province's library is a secured facility for cores and samples collected under various acts.
- Ontario: The government maintains a library of core samples obtained from drilling activity in the province.

Australia

Exploration drill core policy in Australia is primarily regulated at the state and territory level, requiring companies to submit representative geological samples to government-managed core libraries to preserve geoscientific data for future use.

<u>Core Submission Requirements</u>

Under state legislation (e.g., the *Mining Act 1978* in Western Australia and the *Mineral Titles Act 2010* in Northern Territory), tenement holders must offer or submit drill core and cuttings to geological surveys.

- Assessment: Not all core is accepted; geological surveys assess offers based on regional significance, rarity (e.g., depths >1000m), and potential for new stratigraphic information.
- Packaging Standards: Core must be delivered in standard commercial trays (metal or plastic preferred), clearly labeled with hole identification and depth markers, and stacked on specific hardwood or plastic pallets.
- Costs: Companies generally bear the expense of transporting core to designated facilities, though these costs may be considered allowable exploration expenditure for the tenement.

<u>Access and Sampling Policies</u>

Once archived in state core libraries (such as those in Perth, Kalgoorlie, Adelaide, or Werribee), core is available for public viewing and research after a short confidentiality period.

- Sampling Rules: Sampling is permitted on a case-by-case basis. Generally, at least quarter-core must remain in the tray to preserve the physical record.
- Destructive Analysis: Non-destructive methods are encouraged. Destructive sampling requires specific approval, and any resulting data (e.g., geochemical or petrological results) must be submitted back to the department within six months.
- Incentive Schemes: Programs like Western Australia's Exploration Incentive Scheme offer up to a 50 percent refund for innovative drilling projects, with the trade-off that the resulting data and core are made public to stimulate further investment.

Comparative Analysis and Summary

Fiscal Incentives: Front-End vs. Back-End Across All Regions

A central pattern emerges when Alaska is compared to other U.S. states, Canada, and Australia:

- **Back-end incentives** (universal):
  All jurisdictions examined allow deduction of exploration and development expenditures for income or mining tax purposes once taxable income or profit exists. Alaska, Nevada, Arizona, Wyoming, Minnesota, Idaho, Utah, Canadian provinces/territories, and Australia all fit this pattern to varying degrees.
- **Front-end incentives** (selective):
  Some jurisdictions provide immediate, exploration-specific support that reduces risk and financing costs *before* a project reaches production.
  - **Alaska and most U.S. states (Nevada, Arizona, Wyoming, Minnesota, Idaho, Utah)**
    - Primarily rely on back-end deductions like exploration tax credits applied to future mining taxes
    - No flow-through share system at the federal or state level; no large, dedicated exploration tax credits or grant programs, with minor exceptions
    - Competitive advantage (if any) arises from low general taxes, predictable regimes, and/or lower operating costs rather than explicit exploration subsidies
  - **Canada (Quebec, Ontario, BC, Yukon, Nunavut)**
    - Combine federal flow-through shares and CEEs with provincial/territorial refundable or nonrefundable exploration tax credits and grants (Canada Revenue Agency, 2024; Government of Quebec, 2024; Government of British Columbia, 2025; YGS, 2023)
    - Governments effectively share a large portion of early exploration risk
  - **Australia (Western Australia, Queensland, Tasmania)**
    - Federal tax system provides exploration deductibility; some past and current programs targeted junior explorers
    - Several states implement co-funded drilling or geophysics programs that directly subsidize exploration outlays

Alaska therefore aligns much more closely with other U.S. states on fiscal design and lags behind Canadian and some Australian jurisdictions that provide significant front-end exploration incentives.

Public Geoscience and Data

Alaska is competitive to strong in geoscience compared with most individual jurisdictions and U.S. states, but Australia and leading Canadian provinces have more systematic, national-scale support.

- **Alaska vs. other U.S. states**
  Alaska stands out with public geoscience support. DGGS and USGS (including Earth MRI) have produced extensive airborne geophysics and modern mapping across frontier belts. Nevada, Arizona, Wyoming, Minnesota, Idaho, and Utah all have strong geological surveys, but their programs often focus on district-scale or commodity specific work. Alaska is unmatched for the scale of airborne coverage over large, underexplored regions.

- **Alaska vs. Canada**
  Quebec, Ontario, BC, Yukon, and Nunavut maintain modern surveys with broad coverage and high-quality digital portals. Alaska is broadly comparable in quality and ambition.
- **Alaska vs. Australia**
  Australia's integrated federal–state system arguably sets the global benchmark for precompetitive geoscience. Alaska's efforts are impressive but smaller in scale and funding.

Infrastructure and Risk Sharing

From an explorer's perspective, Alaska's AIDEA infrastructure support is valuable but geographically limited. Direct co-funding of exploration, as seen in Yukon and several Australian states, delivers more immediate financial relief.

- **Alaska** has used AIDEA to finance or cofinance mining-related infrastructure (roads, ports), which can substantially improve exploration and development economics in connected regions. This is relatively unique in the U.S. context.
- **Other U.S. states** generally benefit from higher baseline infrastructure availability (roads, rail, grid, etc.) but lack project-specific development banks like AIDEA. They rely more on private capital and general economic development tools.
- **Canada** combines some infrastructure programs (especially in the north) with direct exploration grants and tax credits.
- **Australia** uses broad national infrastructure programs and, in some states, co-funded exploration schemes (e.g., grants for drilling) that directly share exploration risk.

Permitting, Land Access, and Social License

For pure exploration (as opposed to mine development), most jurisdictions allow relatively streamlined, low-impact exploration permissions on public/state land. More complex multi-agency approvals are generally required for major drilling or infrastructure.

Alaska's permitting conditions are similar in complexity to those of other western U.S. states and Canadian or Australian jurisdictions where federal environmental law and Indigenous rights must be considered. Differences in exploration stage permitting are generally less significant for investor decisions than fiscal and cost factors.

Mineral Exploration Project Reporting and Preservation of Drill Core

Alaska requires minimal exploration reporting compared to both Canadian (NI 43-101) and Australian (JORC Code) requirements. Australian requirements for the preservation of mineral exploration drill core are more stringent than both Canadian and Alaskan policy.

Conclusions

When compared with a broader set of jurisdictions, Alaska's strengths and weaknesses are clearer:

- **Strengths**
  - Exceptional geological endowment and critical mineral potential
  - Strong public geoscience programs that are competitive with leading jurisdictions
  - Innovative infrastructure financing model (AIDEA) not commonly found elsewhere in the U.S.
- **Weaknesses**
  - Absence of front-end, exploration specific fiscal incentives such as flow-through shares, refundable exploration credits, or co-funded drilling grants, which are common in Canada and present in several Australian states

- Higher logistics and climate-related costs than many comparator jurisdictions (Nevada, Arizona, Utah, Idaho, Minnesota, large parts of Australia)
- Lack of requirements for mineral exploration reporting compared to competitive Canadian and Australian jurisdictions, although many reports on Alaska exploration projects are prepared by Canadian and Australian public companies

Alaska resembles other U.S. states in its reliance on back-end tax deductions rather than front-end exploration support, and this places it at a disadvantage relative to Canada and Australia in the global competition for high-risk exploration capital. Thoughtfully designed, targeted credits or grant programs, combined with continued investment in geoscience and infrastructure, could significantly enhance Alaska's attractiveness while preserving fiscal discipline and environmental protections. Table 7 summarizes these findings.

STRATEGIES TO INCREASE INDUSTRY EXPLORATION IN ALASKA FOR CRITICAL MINERALS

Through comparisons with other jurisdictions and in other sections of this report, many different strategies to increase industry exploration have been mentioned. This section condenses these ideas, as well as a few newly introduced topics, into potential areas of improvement or new actions.

Developing Exploration Targets

Strategy: Lowering exploration risk will allow for new exploration targets

Any strategies that seek to increase exploration for critical minerals in Alaska are essentially strategies to increase exploration for all minerals. As highlighted in earlier sections of this report, most critical minerals occur with other minerals in ore deposits. Many deposits have critical minerals that are considered coproduct or by-product or occur in lower quantities or lower concentrations than the dominant metal or mineral in the ore deposit.

For example, silver, arsenic, antimony, bismuth, tellurium, and other metals are often associated with gold. Gold exploration can lead to exploration and discovery of critical minerals associated with gold deposits.

Critical minerals can also be explored in unconventional sources and places, such as mining, industrial, and energy waste products (tailings, coal fly ash, etc.), offshore deposits, and non-traditional, onshore deposits like coal and volcanic ash. To date, critical minerals in these types of deposits are internationally underexplored.

The most important factor influencing mineral exploration for certain metals or ore deposit types is market conditions. Economic factors play a crucial role in mineral exploration because they determine whether a mineral deposit is worth exploring, developing, and eventually being mined. For example, an upward spike in gold prices generally leads to increased exploration in known gold belts (Chappelle, 2024). Exploration is high-risk and often funded by venture capital or junior mining companies. Investor confidence, often tied to commodity prices, leads to increased capital available for mineral exploration during times of high commodity prices and favorable economic conditions.

Industry's Perception of Exploration Risk in Alaska

Strategy: Develop a more positive perception of Alaska as a place to do business through proactive, consistent, and transparent communication

The perceived or real mineral potential of a region or state is one of the underlying conditions that impacts the ability to attract mineral exploration funding. Alaska has been viewed as highly prospective for minerals and other natural resources since early explorations over a century ago. One qualitative way to compare Alaska's mineral potential to other jurisdictions worldwide is by an annual survey of mining and exploration companies.

Table 7. Summary of Mineral Exploration Incentives for Alaska, Selected U.S. states, Canada, and Australia. Acronyms are defined in preceding text.

Jurisdiction (Region)	Front-End Incentives (Qualitative)	Back-End Incentives (Qualitative)	Public Geoscience (Qualitative)	Notes
Alaska (United States)	None	Moderate–Strong – Exploration incentive credit (up to 50% of qualified spend; up to $20M, 15-year carry; applies to MLT, CIT, royalties) + general deductibility	Strong – DGGS + USGS Earth MRI; extensive airborne geophysics, mapping, GMC holdings	AIDEA infrastructure (DMTS; Ambler/West Susitna proposals); strong pre-competitive data; high logistics costs
Nevada (United States)	None	Moderate – Net proceeds tax allows deductibility; no state CIT	Moderate – NBMG strong mapping/data	Generally efficient permitting; low overall tax burden
Arizona (United States)	None	Moderate – Deductibility via severance/CIT frameworks	Moderate – AZGS datasets; strong endowment, established districts	Physical/logistical advantages; major copper jurisdiction
Idaho (United States)	None	Moderate – Deductibility; mine license tax (1% net profits) + CIT	Moderate – IGS mapping/critical minerals focus; limited regional geophysics	Lower logistics cost vs. AK; supportive but no targeted front-end
Utah (United States)	None	Moderate–Strong – Transferable exploration tax credit (SB250) ties to severance liability; carry forward) General deductibility; nonrefundable, transferable credit	Limited–Moderate – UGS mapping; limited minerals geophysics	Good access/infrastructure; credit resembles AK's timing (post-liability)
Wyoming (United States)	None	Moderate – Deductibility within severance/royalty regime	Limited–Moderate – WSGS; some Earth MRI airborne	Supportive political climate; few exploration-specific tools

Jurisdiction (Region)	Front-End Incentives (Qualitative)	Back-End Incentives (Qualitative)	Public Geoscience (Qualitative)	Notes
Minnesota (United States)	None	Limited–Moderate – Deductibility; multiple production/occupation/gross proceeds taxes	Moderate – MGS/MNDNR mapping, drill data; no dedicated airborne program	Complex tenure mix; strong infrastructure; rigorous environmental oversight
Federal (Canada)	Strong – Flow-Through Shares: 15% METC; 30% for critical minerals; 100% CEE expensing; stackable	Strong – CDE 30% declining balance; indefinite carry; stack with provincial regimes	Strong – GSC national programs; portals; broad coverage	Hallmark front-end system greatly lowers cost of capital for juniors
Quebec (Canada)	Strong – Generous refundable provincial exploration tax credits, enhanced in remote regions; stacks with federal FTS/CEE	Strong – Mining profit tax with allowances	Strong – Robust survey & digital portals	Frequently top-ranked for exploration attractiveness; aggressive incentives
Ontario (Canada)	Strong – OFFTS (prov. credit) + OJEP grants (up to C$200k; Prospectors Stream up to C$50k; Indigenous participation add-on) + federal stacking	Strong – Deductibility under mining tax + CEE/CDE	Strong – OGS mapping, airborne geophysics, geoscience labs	Mature supply chain + grants + flow-through = highly favorable
British Columbia (Canada)	Strong – METC (20–30% typical; project/location dependent); stacks with federal FTS/CEE	Strong – Standard deductibility + provincial mining tax structure	Strong – BCGS mapping, geophysics, annual syntheses	Front-end credit + infrastructure and stable framework

Jurisdiction (Region)	Front-End Incentives (Qualitative)	Back-End Incentives (Qualitative)	Public Geoscience (Qualitative)	Notes
Yukon (Canada)	Strong – YMEP cost-share grants (grassroots) + federal flow-through	Strong – Standard provincial/territorial deductibility; federal stacking	Strong – YGS mapping, geophysics, assessment reporting	Northern logistics like AK; direct grants de-risk early work
Nunavut (Canada)	Strong – NPP grants (prospectors) + DIG program (up to 25% of eligible costs; annual cap C$250k; lifetime cap C$500k) + CESP community engagement grants	Strong – Federal stacking (FTS/CEE/CDE)	Strong – CNGO partnership; extensive federal survey inputs	Strong territorial programs targeted at early-stage risk
Federal (Australia)	Strong – JMEI (exploration tax credits passed to investors; refundable offsets/franking); CMPTI (10% tax offset on eligible processing); A$2B Critical Minerals Facility (finance)	Strong – General deductibility; national financing/loan programs	Strong – Geoscience Australia; Exploring for the Future (large-scale)	National system rivals Canada's for front-end capital efficiency
Western Australia (Australia)	Strong – Exploration Incentive Scheme: co-fund drilling/geoscience (≤50%)	Strong – Deductibility within royalty/profit-based frameworks	Strong – State survey + federal integration	Large, competitive rounds; rigorous merit-based co-funding
Queensland (Australia)	Strong – Collaborative Exploration Initiative (CEI): merit-based funding for under-explored areas/innovative techniques	Strong – Deductibility; supportive state policies	Strong – State survey + federal integration	Targets new regions/innovative methods

Since 1997, the Canadian Fraser Institute has conducted an annual survey of mining and exploration companies to assess how mineral endowments and public policy factors such as taxation and regulation affect exploration investment (Mejia and Aliakbari, 2025). The Fraser Institute's mining survey is an informal survey that attempts to assess the perceptions of mining company executives about mineral potential and various public policies that might affect a jurisdiction's hospitality to mining investment. The Fraser Institute's annual mineral industry survey and rankings is one of the few metrics available to measure perceived mineral potential and policy perception. The 2024 Fraser Institute Annual Survey of Mining Companies was sent to approximately 2,289 exploration, development, and other mining-related companies around the world (Mejia and Aliakbari, 2025). The companies that participated in the survey reported exploration spending of $5.9 billion in 2023 and $6.0 billion in 2024, approximately 27 percent of the total non-ferrous global mineral exploration budgets (Natural Resources Canada, 2025). Results from the 2025 survey will be released mid-2026.

Table 8 shows Alaska's rank for mineral potential, policy perception, and investment attractiveness for the past 15 years. Figure 11 graphs these results over the same period. Predictably, the results vary from year to year, likely depending on the survey respondents' yearly experience, market conditions, and specific events in the Alaska mining industry.

Table 8. Alaska's ranking in the Fraser Institute annual mineral industry survey from 2010 to 2024. Data from Mejia and Aliakbari (2025) and previous published reports.

Alaska Rank in Fraser Institute Survey Results															
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Investment Attractiveness Rank	9	2	7	5	12	6	14	10	5	4	5	4	11	11	3
Policy Perception Rank	21	27	20	29	38	23	23	29	26	17	13	13	13	19	17
Mineral Potential Rank	1	1	5	1	3	2	15	5	3	7	5	2	15	13	1

Alaska was ranked #1, best in the 2024 survey, for mineral potential among 82 worldwide jurisdictions. Alaska averaged a fifth-place ranking over the past two decades compared to 65 to 90 plus worldwide jurisdictions included in the survey over the period. Based on these results, Alaska is perceived to have one of the highest mineral potentials in the world based on its geology and metallogenic endowment.

Alaska ranks lower in the Fraser Institute study on policy perception regarding mining. The policy perception portion of the survey measures the attractiveness of a jurisdiction based on policy factors such as onerous regulations, taxation levels, the quality of infrastructure, and the other policy related questions (Mejia and Aliakbari, 2025). Policy questions in the survey include uncertainty concerning the administration, interpretation, and enforcement of existing regulations; environmental regulations; regulatory duplication and inconsistencies; taxation; uncertainty concerning disputed land claims and protected areas; infrastructure; socioeconomic agreements; political stability; labor issues; geological database; and security.

Alaska ranked 17th out of 82 for policy perception in the 2024 survey. Notably, labor regulations, taxation regime, security, and political stability were ranked favorably, while regulatory duplication, protected areas uncertainty, environmental regulations uncertainty, and infrastructure quality negatively impacted Alaska's ranking. One comment highlighted in the survey was "The Pebble Mine permitting process is an example of a policy that deters investment due to the uncertainty it creates for investors in mining" (Mejia and Aliakbari, 2025).

Alaska's policy perception rank has averaged 22 over the past two decades. This rank is roughly in the top quartile of all jurisdictions included in the surveys. Infrastructure quality and protected areas uncertainty have consistently been in the lower half to lowest quartile of the survey rankings over the years.

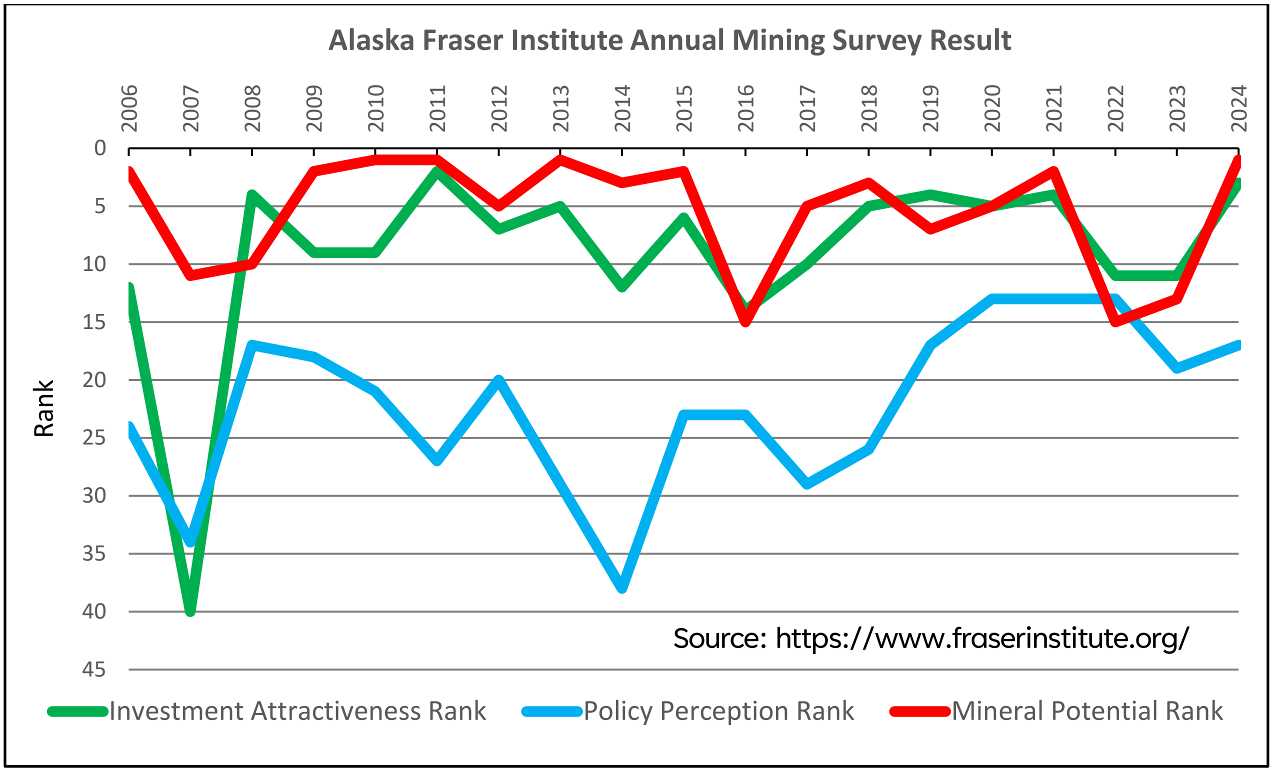

Figure 11. Alaska's ranking in the Fraser Institute annual mineral industry survey from 2006 to 2024. Graph shows the top 45 worldwide jurisdictions, with one being highest and top ranked of all jurisdictions. Data from Mejia and Aliakbari (2025) and previous published reports.

The Fraser Institute survey produces an Investment Attractiveness Index that is weighted 40 percent by policy and 60 percent by mineral potential (Mejia and Aliakbari, 2025). Alaska has averaged ninth ranking over the past two decades. In the 2024 survey, Finland ranked first, Nevada ranked second, and Alaska ranked third (Mejia and Aliakbari, 2025). The remaining top 11 jurisdictions, ranked in order, were Arizona, Sweden, Saskatchewan, Newfoundland and Labrador, Guyana, Norway, and Utah.

Alaska's generally top 10 ranking for investment attractiveness indicates that Alaska has favorable factors to attract mineral exploration investment. The survey results also indicate that there are factors that negatively impact investment decisions, and government improvement in policies and infrastructure can influence investment attractiveness.

Role of Mining Advocacy Organizations and Boards

Strategy: Address concerns of mining advocacy organizations and boards:

- *Develop effective state incentives/suggest new federal incentives*
- *Enhance availability of geologic information*
- *Provide appropriate staffing for permitting agencies*
- *Improve infrastructure for access to land and power*
- *Develop an informed, ready workforce*

The Alaska Miners Association (AMA) publishes yearly issues of concern for State of Alaska and federal policies. The 2025 federal issues of concern for the Alaska mining industry are found in Appendix C and at AMA (2025). The 2025 state issues of concern for the Alaska mining industry are found in Appendix D and at AMA (2025b).

The State of Alaska issues of concern identified by the Alaska Miners Association are grouped into the following categories: Alaska's permitting system, water policy, fiscal policy, equitable local taxation, ballot initiative reform, funding disclosure for nonprofit advocacy, land and mineral management, support Alaska statehood defense efforts, mining education and training, and statewide policy impacts.

Strategies to increase or incentivize mineral exploration are not completely separate from strategies or actions needed to streamline or encourage development and production of minerals. A clear path from exploration through development of a mining project to production of payable commodities is highly attractive to the mineral industry and will encourage increased investment in Alaska's mineral industry. Table 9 lists broad categories of state-level incentives for mineral exploration and development.

The AMA and the Alaska Minerals Commission have not advocated for front-end exploration incentives like grants, loans, or co-funding of exploration programs. This lack of advocacy implies that the Alaska mineral industry does not believe that front-end incentives are necessary. If the state were to consider implementing any front-end incentives for mineral exploration, then consultation with the Alaska Miners Association would be prudent.

The AMA and the Alaska Minerals Commission advocate for support of DGGS and USGS public geoscience. Baseline geological mapping and collection of geochemical and airborne geophysical data provide new information in underexplored mineral belts with high mineral potential, spur mineral exploration, and serve as a means for increasing future state revenue (Appendix D; Alaska Minerals Commission, 2025). Publicly available data provides explorers an advantage when selecting areas to claim on State of Alaska land and therefore makes that investment more attractive when compared to other states or countries that lack such information (Alaska Minerals Commission, 2025). Federal programs such as Earth MRI fund this baseline geological research through grants to state geological surveys.

Table 9. Types of state-level incentives for mineral exploration and development.

Incentive Type	Description
Grants and Loans	Direct financial support for exploration and infrastructure
Tax Credits	Reductions in severance, income, or property taxes
Royalty Reductions	Lowered royalty rates for critical mineral production
Public Geoscience	Investment in geologic mapping, geophysics, geological data
Permitting Support	Streamlined or expedited permitting processes
Infrastructure Support	Investment in roads, power, and water access to remote sites

Other federal programs that contribute data to the public database available to mineral explorers include CORE-CM and the proposed Alaska Critical Mineral Accelerator as part of the National Science Foundation's Regional Innovations Engines Program (DOE, 2025e; Boyce, 2025). These critical mineral programs are supported by Alaska's mineral industry and program results have attracted additional investment in mineral exploration. The Alaska Minerals Commission recommends appropriation of state matching funds to enable

DGGS, the University of Alaska, and other state agencies to leverage federal funds for these and other programs that support assessment of Alaska's critical minerals (Alaska Minerals Commission, 2025).

Alaska's permitting process demonstrates that Alaska is open for business and that the state is a key location to grow America's domestic mining industry, including with projects that focus on critical minerals. Providing clear, concise guidance documents and online tools that lead to better communication between permitting agencies and permittees is an enormous benefit to the mining industry. OPMP is dedicated to guiding industry through an efficient and successful permitting process, but it does not determine state and federal policies, and staff must navigate existing processes. Nevada is renowned for efficient, industry-friendly permitting policies, and Alaska may want to review the current regulatory process in Nevada to identify possible efficiencies for Alaska.

The Alaska Miners Association and the Alaska Minerals Commission also recommend that state regulatory agencies are provided with adequate resources to attract and retain qualified personnel with the expertise to efficiently and durably permit large resource projects that will grow Alaska's economy (Appendix D; Alaska Minerals Commission, 2025).

Lack of infrastructure in Alaska affects all Alaska businesses, including mining. Costs of mineral exploration would be lowered by improved and additional infrastructure like access and power. State- and federal-funded projects that seek to improve or modernize transportation and shipping routes, electricity generation and distribution, and energy sources should consider natural resource exploration, development, and extraction when evaluating project benefits (Alaska Minerals Commission, 2025). Infrastructure projects that leverage responsible resource exploration and development are supported by the Alaska Miners Association and would sustain and grow the state's economy (Appendix D).

One strategy to increase exploration for critical minerals is to provide more land access to areas with high critical mineral potential. Access projects like the Ambler Access Project (Ambler Road)and the West Susitna Access Project are being developed to access mineral-rich areas with known mineral deposits. These access projects will likely spur further development along these roads after they are built. Mineral resource assessments conducted by DGGS and USGS are identifying geologically permissive areas for critical mineral deposits in Alaska. Mineral prospectivity analyses could be used to prioritize other AIDEA-supported infrastructure that unlocks exploration districts.

Finally, critical mineral exploration should be supported by educating and training Alaskans about critical minerals and the mineral industry. State of Alaska financial support for the Alaska Resource Education program, workforce developments programs like certificate programs and vocational/technical education, and science -technology-engineering-mathematics(STEM)-based education, would facilitate educating an upcoming workforce about natural resource industry careers and the importance of natural resources in modern society. Any initiative to expand minerals development must also continue to develop a home-grown workforce that understands and thrives in Alaska's unique operating conditions (Alaska Minerals Commission, 2025). A highly trained Alaskan workforce can be grown and maintained through support of mining and geology related degree and occupational certificate programs in the University of Alaska system, including the University of Alaska Fairbanks College of Engineering and Mines, the Mining and Petroleum Training Service, the University of Alaska Southeast Center for Mine Training, and the Prince William Sound College Millwright Program.

Exploration Program Reporting and Drill Core Archiving Requirements

Strategy: Consider mandatory exploration reporting in Alaska similar to Canadian and Australian standards and mandatory drill core archiving similar to Australia.

Reporting standards and public data access have been critical to Canada's and Australia's success in enticing new mineral exploration, development, and production (Ellis, 1999). Alaska does not mandatorily collect detailed data and samples from instate exploration. Several presentations at the 2025 Alaska Miners

Association (AMA) fall convention highlight future possibilities in state data and sample management that could benefit Alaska exploration (AMA, 2025). A significant amount of data generated by exploration on public lands is not publicly available (Retherford, 2025). In Australia, mineral exploration data are treated as a public resource (Eley, 2025). This public datset has fueled a robust mineral exploration industry for decades. Australia's experience demonstrates that systematic reporting and public data access shorten exploration cycles, reduce duplication, and attract investment. By adopting similar frameworks, Alaska could unlock its full mineral potential, thereby transforming isolated private datasets into a shared foundation for the next generation of discoveries. (Eley, 2025). DGGS has information technology and curatorial skills to preserve and house critical mineral resource information and samples (Johnson, 2025).

Select Additional Strategies

Strategy: Fiscal incentives and other strategies noted or implied in section, COMPARING ALASKA'S MINERAL EXPLORATION INCENTIVES WITH SELECTED U.S., CANADIAN, AND AUSTRALIAN JURISDICTIONS

- *State and industry can better leverage U.S. federal programs and incentives*
- *Reduce or eliminate corporate income tax, such as in Nevada*
- *Consider grant-based matching funds for mineral exploration, such as in Wyoming*
- *Develop a front-end exploration tax credit or flow-through mechanism equivalent to those in Canada*
- *Consider direct financial support to exploration efforts, such as in Australia*
- *Consider permitting guidelines similar to Nevada's mature permitting systems*
- *Consider creation of mining laws specific to a sector of mining (perhaps critical minerals), such as in Minnesota*
- *Revert drilled exploration core to state ownership when a claim (lease) terminates, such as in Minnesota*
- *Consider requiring annual submittal of a technical report of exploration work completed, such as in Canada and Australia*

PERMITTING

National Mining Association Study

According to the National Mining Association, it takes an average of seven to 10 years to secure permits needed to commence mining operations in the U.S. due to the country's inefficient permitting system (SNL Metals & Mining, 2015). The U.S. permitting process is three to five times longer than in Canada and Australia. Canada and Australia have stringent environmental regulations similar to the U.S., but the average permitting period in those countries is two years (SNL Metals & Mining, 2015).

In the U.S., the requirement for multiple permits and multiple agency involvement is the norm, as is the involvement of other stakeholders including local indigenous groups, the general public, and nongovernmental organizations. In Canada and Australia, the timeline for the government to respond is more clearly outlined, the specification of lead agencies is clearer, and the responsibility for preparing a well-structured environmental review is given to the mining company, not the government (SNL Metals & Mining, 2015).

Three U.S. mines in Arizona, Alaska, and Minnesota served as case studies for the research by the National Mining Association. In one example, the study found that after eight years of delay the value of Arizona's Rosemont Mine dropped $3 billion. Alaska's Kensington Mine suffered 20 years of mining delays while the capital cost of building the mine increased by 49 percent (SNL Metals & Mining, 2015).

The U.S. mine permitting process diminishes the value of a minerals project, underscoring the urgent need for a streamlined permitting process. The study finds that a duplicative permitting process that can delay mining projects a decade or longer is hindering the U.S.'s ability to meet a rising demand for minerals (SNL Metals & Mining, 2015). An average domestic mining project can lose a third of its value due to permit delays, and increased cost and investment risk resulting from the delays can in turn cut the expected value of a mine in half. This effect is compounded as the delays increase. As the value of investment goes down and the years go by, a project can become financially unviable.

The entire mine development process stretches far beyond the permitting stage. One study found it takes an average of 29 years for mines to go from discovery to production in the U.S. (S&P Global Market Intelligence, 2023, 2024). This is the second longest lead time in the world, better only than Zambia's lead time of 34 years. While developing a mine in Canada or Australia can also take a long time, with respective average times of 27 and 20 years, those mines do reliably enter production (S&P Global Market Intelligence, 2024).

This extended process in the U.S. isn't due to environmental protections alone, but to a disjointed and duplicative process that often requires miners to engage with multiple federal agencies, sometimes with conflicting jurisdictions. The permitting and development process is often accompanied by extensive litigation, including frivolous litigation by special interest groups seeking to halt mining or other development projects (S&P Global Market Intelligence, 2023).

Loeffler and Watson Study

A recent presentation at the 2025 Alaska Miners Association annual conference focused on the length of time to permit a new mine in the U.S. (Loeffler and Watson, 2025). The presentation discussed permitting for all projects and then concentrated on mining projects.

The presentation highlighted preliminary results from an analysis of time to complete an Environmental Impact Statement (EIS) on projects as part of the federal permitting process under NEPA. The study involved 1,903 projects across the U.S. from 2010-2024. The EIS was used as a proxy for permit times. Figure 12 shows the major steps of starting the EIS process and eventually successfully being issued permits.

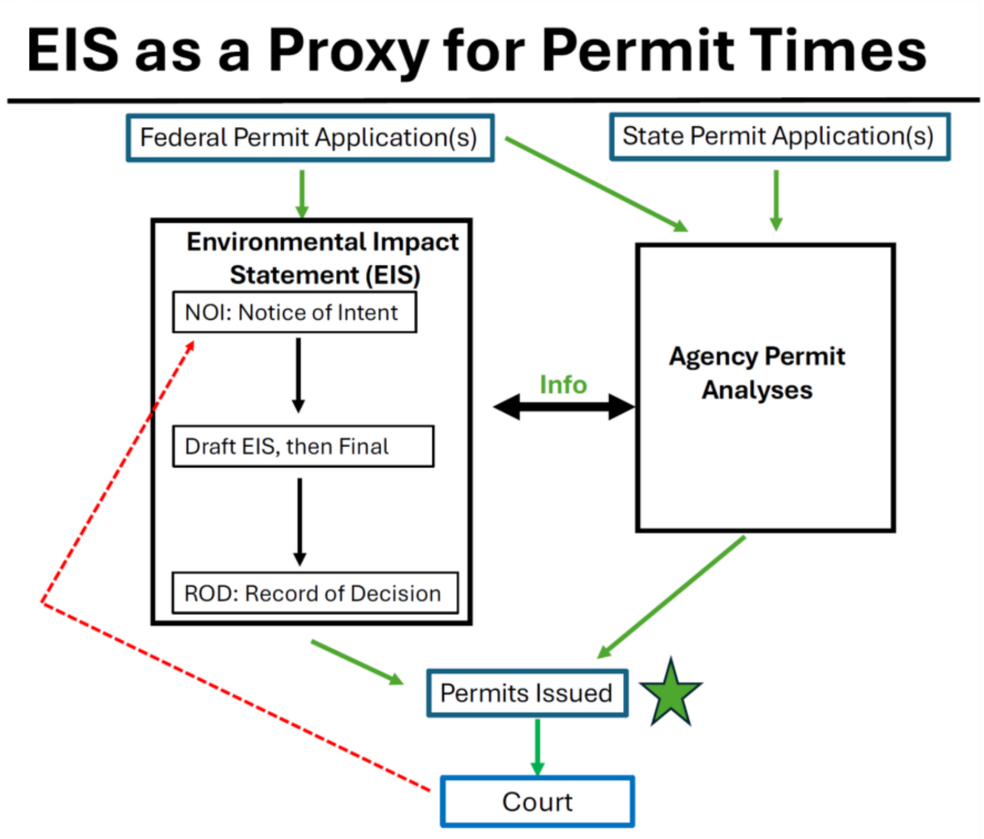

Figure 12. The process for submitting a federal permit under NEPA (from Loeffler and Watson, 2025).

The study's preliminary results show that the median time to complete an EIS was 3.47 years, and the mean time to complete the process was 4.45 years (fig. 13). The process has become faster in recent years, but different federal agencies varied in time of processing an EIS, with the U.S. Forest Service averaging 4.5 years, U.S. Bureau of Land Management averaging 4.7 years, and the U.S. Army Corps of Engineers averaging 8.4 years (Loeffler and Watson, 2025).

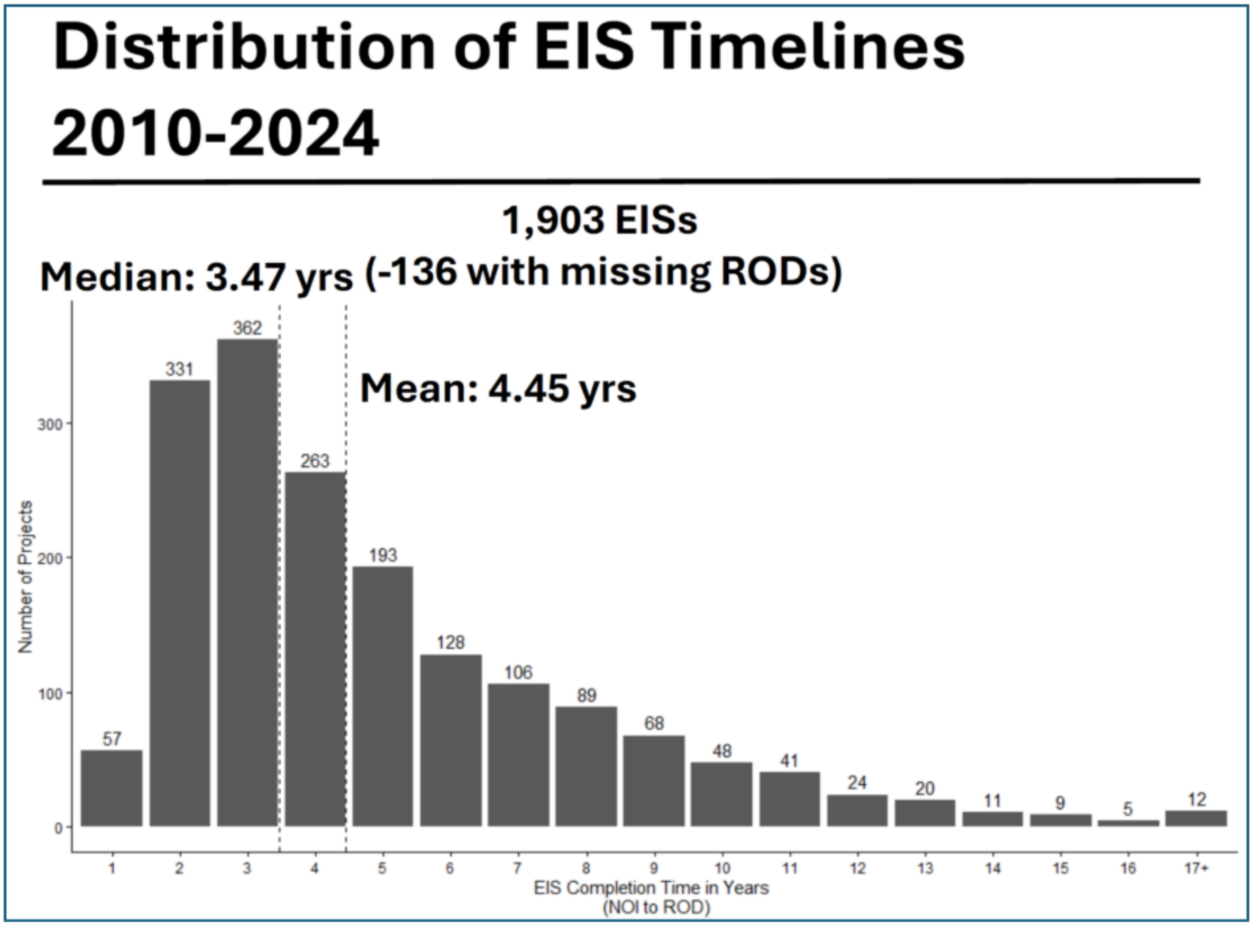

Figure 13. Distribution of EIS timelines. Data and figure from Loeffler and Watson (2025).

The study also evaluated EIS timelines solely for mining projects. These data consist of 47 mining projects that were in the EIS process from 2000 to 2024. An EIS was completed for 38 of the 47 projects, with nine projects not completing the process. Five of the mine projects are still in the EIS process, and four mine projects were withdrawn (Loeffler and Watson, 2025). The results are summarized in Table 10.

Table 10. Mining projects studied and the results of the EIS process. From Loeffler and Watson (2025).

Mines with an EIS in Process 2000-2024	**47**	
EIS Incomplete	**9**	
Still in process		5
Withdrawn		4
EIS Complete	**38**	
Mines operating		22
Mines stopped due to federal litigation		9
Mines not operating for some other reason		7

The 38 mine projects that finished the EIS process (22 of those mines are currently operating) are located across the. One third of the mine projects are in Nevada; one third are in Idaho, New Mexico, and Alaska; and one third are elsewhere in the U.S. The mine projects in Alaska (Pogo Mine, Kensington Mine, Donlin Gold Project, and Pebble Project) are on federal, state, or Native lands. The mine projects in the western states are on federal land, and three mine projects are on private land. According to Loeffler and Watson (2025), the lead agency for permitting these mine projects was the U.S. Bureau of Land Management for roughly 60 percent, U.S. Forest Service for roughly 30 percent, and the U.S. Army Corp of Engineers for roughly 10 percent. No data were presented as to the length of time that state or local agencies took to complete their parts of the permitting process. Gold was the primary commodity for 43 percent of these new mine projects, copper was primary for 17 percent of these mine projects, phosphate was primary for 11 percent, and 29 percent of the new mine projects were for some other commodity.

The median time to complete the EIS process for these mining projects from 2000 to 2024 was 3.6 years. However, the permitting time was highly variable, with times ranging from less than one year to approximately 11 years. The process seems to be getting faster. Over the last eight years, eight mining projects completed the EIS process, averaging roughly two years (Loeffler and Watson, 2025). None of the recent mining projects took greater than 3.5 years to successfully complete the EIS process.

Loeffler and Watson (2025) conclude that a mining project currently starting the EIS process would take an average of 2.5 years to complete the permitting process to a Record of Decision (ROD). On average, it takes three months post-ROD to complete the permitting process and be issued permits.

The preceding analysis and conclusions did not involve litigation. The study (Loeffler and Watson, 2025) found that 15 of the 39 mine projects, 38 percent, that completed the EIS process were sued. Nine of those projects resolved their litigation, and six projects have ongoing litigation as of September 2025. Federal litigation time, as defined in this study, included time from the issuance of a ROD to a final court decision, plus time spent on a Supplemental EIS (SEIS) if required by litigation, plus additional rounds of litigation if they occur.

The study found that average litigation time, if resolved by September 1, 2025, was 6.7 years. The median time was 5.4 years. The authors state that these timeframes are considered underestimates (Loeffler and Watson, 2025). As with the time length for completing the EIS process, litigation times are highly variable.

The study found that litigation was filed for 38 percent of the mining projects. An average expected litigation penalty as stated by Loeffler and Watson (2025), is average litigation time multiplied by the average chance of litigation. The expected litigation penalty is 2.5 years (6.7 years X 0.38).

The permitting time for a new mine project in the U.S. is a sum of the above time to permit, processing permit time, and litigation penalty. It takes on average 2.5 years to complete the EIS process through a Notice of Intent, and a ROD. The ROD to final issuance of permits averages 0.25 years. The expected litigation penalty is 2.5 years. Thus, the average expected time to permit a new mine in the U.S. is 5.25 years (Loeffler and Watson, 2025).

The authors note that the Nevada EIS process is about one year faster than elsewhere in the U.S. The authors speculate that this could be due to familiarity with projects and experienced staff in Nevada offices (Loeffler, personal communication).

Alaska mining projects are more likely to be litigated. Three of the four mining projects in this analysis were or are litigated, with the Kensington Mine project taken to the U.S. Supreme Court. Therefore, the expected litigation penalty is higher for Alaska mining projects and the overall time permitting a mining project is also expected to be longer (Loeffler and Watson, 2025). Alaska mine projects are generally more complex than mining projects elsewhere in the U.S. This complexity adds to EIS page length, which subjectively may add to longer reviews of EIS documents.

OPMP Overview

The Alaska Department of Natural Resources, Office of Project Management and Permitting (OPMP), may coordinate the permitting of large mine projects in the state, per Alaska Statute (AS) 38.05.020(b)(9). The State of Alaska has developed the Large Mine Permitting Team (LMPT) process to coordinate much of the state agency permitting for such projects (OPMP, 2024). This process, which may also integrate with federal and local government permitting processes, seeks to improve mine permitting by implementing a robust, coordinated process that is predictable, consistent, and responsive to the needs of regulatory agencies and project applicants. The process also seeks to provide relevant information to the public in a transparent, understandable way (OPMP, 2024).

In Alaska, new mines have been permitted recently in as little as three months, not including Environmental Impact Assessments and federal NEPA requirements, with OPMP assistance navigating the state permitting process. The Gil Mine, a satellite deposit to the Fort Knox Mine near Fairbanks, began operation in 2021 with individual state authorizations taking one to two months from the time a complete application was received to rendering a final decision. The Manh Choh Mine near Tok began mining in late 2023 after receiving state approval for Plan of Operations, Reclamation and Closure Plan, Waste Management Permit, Temporary Water Use Authorizations, and financial assurances that took one to six months from the time complete applications were received to final decisions.

Permitting Summary

The National Mining Association determined that the permitting process for a new mine in the U.S. averages seven to ten years (SNL Metals & Mining, 2015). The U.S. permitting process is three to five times longer than the process in Canada and Australia.

Loeffler and Watson (2025) concluded that the average expected time to permit a new mine in the U.S. is 5.25 years. Nevada's permitting time is about one year faster than the average, while Alaska's permitting time is expected to be longer (Loeffler and Watson, 2025).

The State, through OPMP, permitted development for two new operating mines , Gil Mine and Manh Choh Mine, in less than 3 months (2021) and less than 6 months (2022), respectively. These timelines are based on the time an individual State authorization from the time a complete application was received to a final decision.

CURRENT AND PROJECTED PRODUCTION OF CRITICAL MINERALS IN ALASKA IN THE NEXT THREE, FIVE, AND 10 YEARS

In their 2022 report, *The Economic Potential of Alaska's Mining Industry,* Loeffler and Watson (2022) present a Mine Development Pyramid to illustrate how a potential mine moves from one stage of development to another (fig. 14). The base of the pyramid rests on Initial Exploration, then moves upward through the additional stages until the mine enters production at the apex of the pyramid. The report placed 110 Alaska projects in various layers of the pyramid based on their development progress between 2016 and 2020.

Mining projects have long timelines. The progression of a mining project from initial exploration to an operating mine is generally a decade or longer. In some cases, like the Donlin Gold Project in southwestern Alaska, the exploration phases and economic evaluation phase spans three decades, with additional time spent in the permitting and development process before actual mining may begin.

Developing scenarios for predicting mineral production in three, five, and 10 years are based on the above pyramid and the timelines associated with Alaska mining projects. Recent federal actions such as FAST-41, the 2025 federal Standardizing Permitting and Expediting Economic Development Act, Defense Production Act grants, and Defense Logistics Agency grants may shorten historical timelines. The State of Alaska signed a Memorandum of Understanding (MOU) with the Federal Permitting Improvement Steering Council in August

2025 to collaborate under the FAST-41 program (State of Alaska, Office of the Governor, 2025). The MOU aims to reduce the average federal permitting time for major projects by approximately 25 percent, shortening the process from roughly 3.6 years to 2.7 years (Lazenby, 2025).

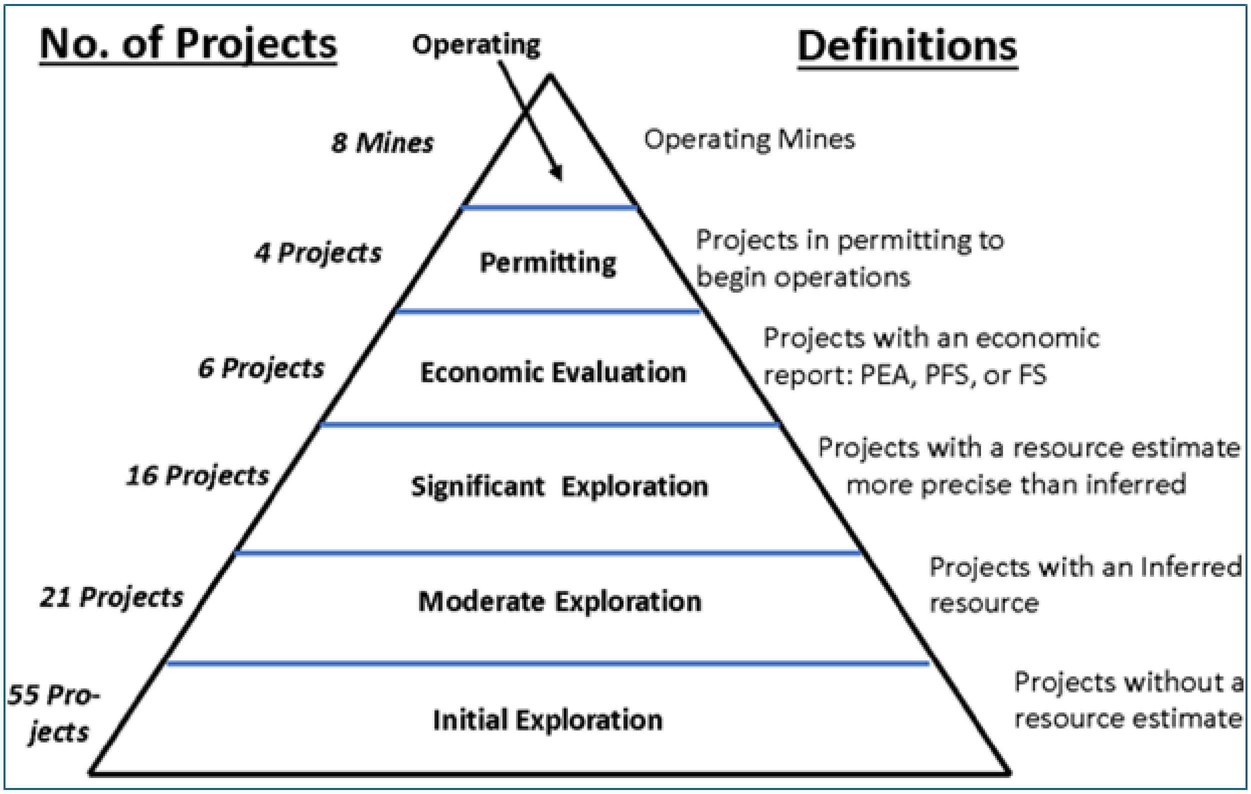

Figure 14. The mine development pyramid (from Loeffler and Watson, 2022).

There is not yet sufficient information to determine whether recent federal actions will shorten permit timelines significantly, or by how much. Some of these actions may also not be applied evenly across all potential mining projects. Therefore, historical timelines for Alaska mining projects will be used to project future mineral production.

A 10-year timeline is relatively short given the factors discussed above. It is assumed that the only large mining projects that could become an operating mine within 10 years would need to be in the economic evaluation or permitting parts of the mine development pyramid. Four projects were in permitting (Donlin Gold, Lucky Shot, Nixon Fork, and Wishbone Hill) and six projects were in economic evaluations (Arctic, Bokan Mountain, Golden Summit, Graphite Creek, Money Knob, and Palmer). The Manh Choh project was considered an extension of the Fort Knox Mine, and the Aktigiruq and Lik projects were considered extensions of the Red Dog Mine (Loeffler and Watson, 2022). The Pebble Project was not considered in the report. The Wishbone Hill Mine project is a proposed coal mine. The project is currently inactive and is working on renewing permits. The project is administered by the Coal Regulatory Program in DNR's Division of Mining, Land, and Water.

DNR's Large Mine Permitting team (LMPT) and OPMP may coordinate the permitting of large mine projects in the state. Mines that are currently coordinated by LMPT and OPMP are Fort Knox Mine, Gil Mine, Greens Creek Mine, Kensington Mine, Manh Choh Mine, Pogo Mine, and Red Dog Mine. LMPT and OPMP coordinated exploration projects are Anarraaq-Aktigiruq, Arctic, Donlin Gold, Graphite One, Illinois Creek, Johnson Tract, Livengood, Niblack, Palmer, and Pebble. These coordinated mines and projects are permitted to operate or in the permitting process for mine development.

The permitting process for natural resource development projects can be complex and lengthy depending on the size and scope of the project. The permitting time frame has a direct impact on projecting future mining production in Alaska in three, five, and 10 years. The average expected time to permit a new mine in the U.S. is 5.25 years, with preliminary data showing that the time to permit Alaska mining projects is longer (Loeffler and Watson, 2025). The permitting process for Alaska state permits is significantly shorter.

Therefore, a project that is not in the permitting process in 2025 will most likely not be through the process in three or five years to begin mine development. Even after final permits are granted, construction and commissioning typically take an additional two to four years for most large-scale mines (S&P Global Market Intelligence, 2023; Minex Consulting, 2025). Thus, Alaska mining projects that are not currently in the permitting phase are unlikely to be producing critical minerals even within 10 years. The most likely projects to fit within a three-, five-, or 10-year window are Alaska mining projects that are currently operating, in the permitting stage, or have undergone economic evaluation.

Placer operations and small lode mines may be developed to produce critical minerals in Alaska. These mine projects are generally less complex and have shorter development timelines. Placer mines and small lode mines generally do not have published mineral resources, so it is difficult to predict production volumes and mine lives. Potential placer and small lode mines are therefore not included in the following scenarios.

Future Alaska Mineral Production

In 2025, Alaska had seven large operating mines, one small hard rock producer, and hundreds of placer gold operations. Alaska's large mines are important producers of critical minerals, with zinc, lead, silver, germanium, and copper produced in 2025. There was no reportable critical mineral production from Alaska placer operations in 2025, but some operations may have produced minor amounts of silver, platinum, and other critical minerals.

To estimate future critical mineral production, past production (Table 4), future production, and upcoming mines should be considered.

The first step at predicting future critical mineral production in Alaska is to look at current mineral producers. Most of the major metal producers publish a minelife based on assumed production rates and current mineral reserves. Table 11 lists Alaska's large mines and announced minelifes.

Table 11. Alaska mines. Each site lists commodities produced and announced or projected minelife. Data modified from Szumigala (2024).

Name	Location	Commodities Produced	Minelife
Red Dog Mine	NW AK	Zinc, lead, silver, germanium	2031
Fort Knox Mine	Interior	Gold (silver)	2030+
Pogo Mine	Interior	Gold (silver)	2030+
Usibelli Coal Mine	Interior	Coal	2075+?
Manh Choh Mine	Interior	Gold, silver	2028
Kensington Mine	SE AK	Gold (silver)	2027
Greens Creek Mine	SE AK	Silver, gold, zinc, lead, copper	2037
Dawson Mine	SE AK	Gold, silver	2075

The next step for predicting future mineral production in Alaska is to look at mining projects that are permitted or in the permitting process. Table 12 is a list of major mining projects with announced project timelines.

Table 12. Alaska mining projects with announced project timelines and potential commodity output. NA indicates Not Announced. Data from Szumigala (2024) and company documents.

Name	Location	Commodities Produced	Mine permitting	Construc-tion	Initial production
Aktigiruq	NW AK	Zinc, lead, silver, germanium	2026	2028	2031
Arctic	N AK	copper, lead, zinc, gold, silver	2026	NA	NA
Donlin Gold	SW AK	gold with minor silver	2012	2027	2031
Johnson Tract	SC AK	gold, silver, copper, zinc, lead	2026	2029	NA
Lucky Shot	SC AK	gold with minor silver	NA	2028?	NA
Palmer	SE AK	copper, lead, zinc, gold, silver, barite	NA	NA	NA
Niblack	SE AK	copper, gold, silver, zinc	NA	NA	NA
Bornite	N AK	copper , possibly cobalt	2026	NA	NA
New Amalga	SE AK	gold	NA	NA	NA
Graphite One	W AK	graphite potentially with REEs?	2025	2027	2031
Golden Summit	Interior	gold with minor silver	NA	NA	NA
Treasure Creek	Interior	antimony, gold			2026
Mohawk Mine	Interior	antimony, gold			2026
Estelle	SW AK	antimony, gold			2027
Bokan Mountain	SE AK	rare-earth elements, uranium	NA	NA	NA
Pebble	SW AK	copper, molybdenum, gold, silver	2017	NA	NA

None of the major mining projects listed in Table 12 are expected to be producing mineral commodities within a three- or five -year period. Expected initial production for the Aktigiruk, Donlin Gold, and Graphite One projects fall within a 10-year timeframe.

Three antimony-gold projects listed in table 12 have announced plans to initiate production in 2026 or 2027. None of these projects have received mining permits or announced antimony reserves. United States Antimony Corporation announced plans to ship antimony ore from mineral leases at the historical Mohawk Mine near Fairbanks to its smelter in Montana. Felix Gold is exploring for gold near Fairbanks at its Treasure Creek property, where it has identified high-grade antimony deposits near the surface. The company says it could begin production later this year if permits are approved. Nova Minerals received a $43.4 million award from DOD to define antimony resources at the Estelle property and to initiate an antimony refining facility in Alaska. Nova Minerals stated that production of antimony would commence in 2026.

The proposed antimony mines are small scale and likely low volume. Production rates or volumes have not been announced. No reserves, defined resources, or expected minelifes have been announced. To acknowledge the possibility of some antimony production in the next several years, 500 tons will be assumed for annual antimony production.

Forecasting mining production for five or 10 years into the future is challenging because the industry is influenced by a complex mix of economic, technological, regulatory, and environmental factors. Mineral prices fluctuate based on global supply and demand, geopolitical tensions, and economic cycles. Advances in extraction, processing, and recycling technologies can alter demand for certain minerals or make previously uneconomic deposits viable. Federal policies may alter permitting timeframes longer or shorter due to political priorities.

Table 13 shows projected mineral production from Alaska hardrock mines for the next several years and as far as 10 years into the future. Mineral production listed in table 13 must be treated with caution due to the uncertainty of the forecast.

Table 13. Projected mineral production from Alaska's mines. Annual production volumes are highly speculative but based on best available data from mine operators and mineral project owners.

Mineral	2025	2026	2027	2028	2030	2035
Zinc (Zn) thousand tons	560–575	540-565	490-505	420-435	350-375	550–700
Lead (Pb) thousand tons	105–136	90-121	80-111	70-96	60-90	100–200
Gold (Au) thousand troy ounces	925–955	925– 955	950-980	960-990	960-990	1,500-1,750
Silver (Ag) million troy ounces	13-15	12-14	10-12	9-11	9-11	11- 18
Copper (Cu) thousand tons	1.5– 2	1.5 – 2	1.5-2	1.5–2	1.5-2	15– 180
Germanium (Ge) tons	8-12	8-11	7-10	6-9	5-8	8-12
Coal million tons	1	1	1	1	1	1
Antimony (Sb) tons	0	500	500	500	NA	NA
Graphite thousand tons	0	0	0	0	0	190

Three-Year Forecast (2028)

This three-year forecast is the least speculative of the three projected mineral production forecasts. Data from tables 11, 12, and 13 are used in this summary.

Alaska's current large hardrock mines will continue to operate through 2028. The Red Dog Mine has announced decreased zinc and lead production, with associated silver and germanium production, over the next three years as the mine reaches its minelife of 2031. The Manh Choh Mine near Tok is expected to produce until 2028 unless additional ore is found. The Kensington Mine has an announced minelife to 2027, but this mine has typically only had one- to two-year minelifes since initial production. The Kensington Mine is expected to be in production past 2030.

Mineral production volumes are expected to be roughly comparable to projected 2025 mineral production volumes, but with reductions in two key operating mines. Zinc production from Red Dog Mine and Greens Creek Mine will range from 420,000 tons to 435,000 tons, about a 170,000 ton drop from 2025 projected production. Lead production from Red Dog Mine and Greens Creek Mine will range from 70,000 tons to 96,000 tons, about a 35,000 ton drop from 2025 projected production. Silver production will drop due to decreased production from Red Dog Mine, even with assumed steady production from Greens Creek Mine. Estimated silver production will be in the nine to 11 million troy ounce range, about a four million troy ounce reduction from 2025 production. Germanium production is expected to drop due to decreased production from Red Dog Mine.

Gold production in 2028 is expected to increase to 960,000–990,000 troy ounces due to increased production at Pogo Mine and steady production at Alaska's other gold producers. The 2028 gold production range is 35,000 ounces greater than the projected 2025 range of 925,000 to 955,000 troy ounces. As discussed previously, there may be some antimony production from gold-antimony deposits in the Fairbanks area and the southern Alaska Range.

Several mining projects may be in the mine construction phase by 2028. The Aktigiruq zinc-lead-silver-germanium project near Red Dog Mine is projected to begin production in 2028. The Donlin Gold project near Aniak is expected to begin infrastructure and mine construction in 2027. The Graphite One project on the Seward Peninsula also announced plans to begin construction in 2027. Less certain is the possibility of construction at Lucky Shot Mine near Willow in 2028.

Five-Year Forecast (2030)

The five-year forecast for Alaska mineral production is more speculative than the three-year forecast. The data used in this forecast are summarized in tables 11, 12, and 13.

Most of Alaska's current large hardrock mines will continue to operate through 2030. The Red Dog Mine will have one year left of projected production and zinc and lead production, with associated silver and germanium production, will be significantly reduced. The Manh Choh Mine is expected to be closed after exhausting its ore reserves. The Kensington Mine has an announced minelife to 2027, but this mine has typically only had one- to two-year minelife since initial production. The Kensington Mine is expected to be in production past 2030.

Mineral production volumes are expected to be reduced compared to projected 2025 and 2028 mineral production volumes. Zinc production from Red Dog Mine and Greens Creek Mine will range from 350,000 to 375,000 tons, about a 200,000 ton drop from 2025 projected production. Lead production from Red Dog Mine and Greens Creek Mine will range from 60,000 to 90,000 tons, about a 45,000 ton drop from 2025 projected production. Silver production will continue to drop due to decreased production from Red Dog Mine, even with assumed steady production from Greens Creek Mine. Estimated silver production will be in the nine to 11 million troy ounce range, about a four million troy ounce reduction from 2025 production. Germanium production is expected to drop to five to six tons due to decreased production from Red Dog Mine.

Gold production in 2028 is expected to remain comparable to 2028 production range of 960,000 to 990,000 troy ounces due to increased production at Pogo Mine and steady production at Alaska's other gold producers. The 2030 gold production range is 35,000 ounces greater than the projected 2025 range of 925,000 to 955,000 troy ounces. Gold production could be greater if Lucky Shot Mine begins production before or during 2030. Antimony production from gold-antimony deposits in the Fairbanks area and the southern Alaska Range is expected to have ended by 2030 as mine reserves are depleted and a large antimony project in Idaho dominates the domestic antimony market.

The large mining projects that began construction during 2027 and 2028 are expected to continue building infrastructure and mine facilities. Initial production from these projects is planned in 2031. It is possible that one or more projects may begin initial production at small volumes in 2030.

10-Year Forecast (2035)

The 10-year forecast for anticipated mineral development and production is highly susceptible to errors based on assumptions of future market and other conditions. Data in tables 11, 12, and 13 are incomplete and at best qualitative assessments.

By 2035, Red Dog Mine is anticipated to be closed and partially reclaimed. The mill facilities will continue to operate and process ore from the underground Aktigiruq Mine. The Aktigiruq Mine should be at full capacity.

Fort Knox Mine will likely be closed, but there is a possibility that the mill could be processing gold and silver ore from other deposits. High gold prices could also make auxiliary gold-silver projects nearby attractive for mining.

The Kensington Mine may have exhausted its gold ore reserves and resources by 2035. Its historically short minelife of one to three years make a 10-year forecast too difficult to predict continued production.

Pogo Mine, Dawson Mine, Usibelli Coal Mine, and Greens Creek Mine are projected to continue production to 2035 and beyond. The Lucky Shot Mine and Donlin Gold Mine should also be producing, with Donlin Gold Mine having a projected million-ounce annual production.

Many of the mining projects listed in table 12 may be in the permitting or construction phase by 2035. It is also likely that one or more projects could be producing critical minerals by 2035. Other projects will likely join these projects along the path to production with continued investment in mineral exploration during the ten years.

Mineral production volumes for 2035 are highly speculative. The addition of one or two new mines would greatly change the production amounts for one or more minerals.

Zinc production is forecast to range from 550,00 to 700,000 tons, and associated lead production ranges from 100,00 to 200,000 tons. Silver production is projected to range from 11 to 18 million troy ounces. Germanium associated with Aktigiruq Mine ores may be produced in the eight-to-12-ton range.

Gold production is projected to increase dramatically. The addition of production from Donlin Gold Mine to other gold-producing mines will boost gold production in the 1.5 to 1.75 million troy ounce range.

Graphite is expected to be produced from Graphite Creek Mine and average 190,000 tons annually. There is potential to produce rare-earth elements from this deposit, but at this time there aren't data to calculate potential production volumes.

Alaskan copper production in 2035 is calculated to be in the 15,000-to-20,000-ton range based on assumed production from the Johnson Tract project. However, if Pebble Mine was to be built and in production by 2035, it would dramatically add to those volumes. For a proposed 20-year operation, Pebble Mine's average annual production is estimated to include 160,000 tons of copper, 368,000 troy ounces of gold, 7,500 tons of molybdenum, 1.8 million troy ounces of silver, and 11 tons of rhenium.

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APPENDIX A: ALASKA SENATE BILL 118, 2024 TEXT

Enrolled SB 118

LAWS OF ALASKA

2024

Source Chapter No.

CSSB 118(FIN) ______

AN ACT

Relating to critical and essential minerals.

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BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

THE ACT FOLLOWS ON PAGE 1

-1- Enrolled SB 118

AN ACT

Relating to critical and essential minerals.

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* **Section 1.** The uncodified law of the State of Alaska is amended by adding a new section to read:

STRATEGIC PLAN FOR CRITICAL AND ESSENTIAL MINERALS; REPORT. (a) It is the intent of the legislature that the state develop a strategy to encourage exploration, development, production, refining, and value-added manufacturing of critical and essential minerals in the state. When considering mineral economics and development and production regulatory frameworks at all levels of government, the strategy must

(1) position state production of critical and essential minerals at the center of production in the United States;

(2) support development of emerging technologies and the manufacturing of the required components;

(3) consider the effects of different regulatory frameworks on development of critical and essential minerals in the state; and

Enrolled SB 118 -2-

(4) maintain the state's existing environmental standards.

(b) Not later than the first day of the Second Regular Session of the Thirty-Fourth Alaska State Legislature, the Department of Natural Resources shall provide a report to the legislature comparing the state's current production and potential future production to national and global production of critical and essential minerals. When determining which minerals are critical and essential, the department may rely on the most recent critical minerals lists published by the United States Department of Energy, the United States Department of Defense, and the United States Department of the Interior, Geological Survey. When developing the report, the Department of Natural Resources may consult with appropriate state and federal agencies, the University of Alaska, industry representatives, and Native corporations. The report must identify strategies to increase industry exploration for and state production and development of critical and essential minerals in the next three, five, and 10 years. The report must compare the state's permitting timelines and exploration incentives with the permitting timelines and exploration incentives in other jurisdictions. The commissioner of natural resources shall post the report on the department's Internet website, submit the report to the senate secretary and chief clerk of the house of representatives, and notify the legislature that the report is available.

(c) Not later than the first day of the Second Regular Session of the Thirty-Fourth Alaska State Legislature, the Department of Commerce, Community, and Economic Development shall provide a report to the legislature identifying the state's role in innovation, manufacturing, and transportation. The report must analyze the potential role of state goods in supply chains critical to the global economy, including the potential use of state goods in electric batteries, solar panels, wind turbines, and connected consumer devices. When developing the report, the Department of Commerce, Community, and Economic Development may consult with appropriate state and federal agencies. The Department of Commerce, Community, and Economic Development may hire a contractor to prepare the report. The report must evaluate whether the state's location is valuable in the global supply chain and identify strategies for the next three, five, and 10 years to develop state innovation, manufacturing, and transportation. The commissioner of commerce, community, and economic development shall submit the report to the senate secretary and chief clerk of the house of representatives and notify the legislature that the report is available.

APPENDIX B: 2025 U.S. CRITICAL MINERALS, WITH BRIEF DESCRIPTION OF USE

From USGS (2025f)

Aluminum, used in almost all sectors of the economy

Antimony, used in lead-acid batteries and flame retardants

Arsenic, used in semiconductors

Barite, used in oil and gas drilling and medical imaging

Beryllium, used to manufacture metal alloys for aerospace and defense

Bismuth, used in nontoxic metals, atomic research, and some medical applications

Boron, used to harden steel and glass and in nuclear energy

Cerium, used in catalytic converters, ceramics, glass, metallurgy, and polishing

Cesium, used in atomic clocks for global positioning systems,

Chromium, used in stainless steel

Cobalt, used in batteries and metal alloys used in extreme temperatures

Copper, used widely in wiring and cables

Dysprosium, used in permanent magnets, data storage devices, and lasers

Erbium, used in fiber optics, optical amplifiers, lasers, and glass colorants

Europium, used in phosphors and nuclear control rods

Fluorspar, used to make synthetic materials and plastics, iron and steel, ceramics, glass, and refineries

Gadolinium, used in medical imaging, permanent magnets, and steel

Gallium, used in semiconductors

Germanium, used in fiberoptics, semiconductors and night vision

Graphite , used in lubricants, batteries, and fuel cells

Hafnium, used in nuclear control rods, semiconductors and aerospace

Holmium, used in permanent magnets, nuclear control rods, and lasers

Indium, used in flat-panel displays and touchscreens

Iridium, used for electrochemical processes and as a chemical catalyst

Lanthanum, used in chemical catalysts, metallurgy, and batteries

Lead, used in batteries, ammunition, glass and ceramics production

Lithium, used in rechargeable batteries

Lutetium, used for medical imaging, electronics, and some cancer therapies

Magnesium, used in metal alloys used by aerospace, automotive and electronics industries

Manganese, used in steel production and batteries

Metallurgical coal, used in steel production

Neodymium, used in permanent magnets, in medical and industrial lasers, and in the production of rubber

Nickel, used to make high-strength steel, and rechargeable batteries

Niobium, used to strengthen steel

Palladium, used in catalytic converters, electronics, and as a chemical catalyst

Phosphate, used in fertilizers

Platinum, used in catalytic converters, aerospace alloys, chemical refining and petroleum processing

Potash, used in most fertilizers

Praseodymium, used in permanent magnets, batteries, aerospace metal alloys, ceramics, and colorants

Rhenium, used in high-performance jet engines and gas turbines

Rhodium, used in catalytic converters, electrical components, and as a chemical catalyst

Rubidium, used in atomic clocks key to global positioning systems (GPS), data network syncing and research and development

Ruthenium, used as catalysts, as well as electrical contacts and chip resistors in computers

Samarium, used in permanent magnets, in nuclear reactors, and in cancer treatments

Scandium, used to strengthen metal alloys, in fuel cells and in high-intensity lighting

Silicon, used in silicon wafers fundamental to semiconductors

Silver, used in electrical circuits, batteries, solar cells, and anti-bacterial medical instruments

Tantalum, used in materials and electronic components that need to withstand high temperatures and harsh environments

Tellurium, used in solar cells, to strengthen steel and copper, and to produce rubber, microchips and laser diodes

Terbium, used in permanent magnets, fiber optics, lasers, and solid-state devices

Thulium, used in lasers, x-ray devices, and metal alloys suitable for industrial products and nuclear reactor components

Tin, used for food and beverage cans, circuit board components and corrosion-resistant metal coatings

Titanium, used as a white pigment and in metal alloys, including for airplanes, spacecraft and military vehicle armor

Tungsten, primarily used to make wear-resistant metals for jet engines, ammunition, and mining and cutting equipment

Uranium, used as a nuclear fuel and medical applications

Vanadium, used to strengthen iron and steel

Ytterbium, used for catalysts, lasers, and metallurgy

Yttrium, used in lighting and display technologies and in high-performance metal alloys

Zinc, used as a coating to protect iron and steel from rust and corrosion

Zirconium, used in nuclear reactors, aerospace heat shields and engine components

Zirconium, used in nuclear reactors, aerospace heat shields and engine components

APPENDIX C: ALASKA MINERS ASSOCIATION – 2025 FEDERAL ISSUES OF CONCERN FOR THE ALASKA MINING INDUSTRY

ALASKA MINERS ASSOCIATION

121 W. Fireweed Suite 120 | Anchorage, Alaska | 99503 | 907.563.9229 | alaskaminers.org

2025 FEDERAL ISSUES OF CONCERN FOR THE ALASKA MINING INDUSTRY

Critical Priorities

Mining in America

Immediately designate White House level resources within the National Economic Council to elevate, prioritize, and coordinate sound domestic mining policy. Prioritize Alaska's vast mineral resources and make the state a leading jurisdiction to increase mining in America.

Permitting Reform

Implement NEPA reforms that provide certainty to project proponents and stakeholders including strict adherence to the scope of the reviews and timelines dictated by Congress. Reform litigation practices to shorten appeal timelines and provide clear sideboards to the scope of litigation against proposed projects and remedies available. Federal agencies must be adequately resourced to efficiently and durably permit large projects that provide a steady supply of minerals and grow our economy.

Critical and Essential Minerals

Support federal incentives for domestic mineral production and processing, and ensure they are applicable to all minerals regardless of the status of the various critical mineral and material lists.

Federal Land Management and Access

Consistent with federal law, including ANILCA, ANCSA, Alaska Statehood Act, and FLPMA, ensure access to and across all federal lands to maintain multiple use as the priority and primary principle of land management.

Define withdrawals in ANILCA 1326 as follows: Notwithstanding any other provision of law, the word "withdrawal(s)" as applied in this Section shall be defined and construed to mean any prohibition or restriction on the development and use of the resources on and within the public lands, including without limitation, lands managed by NPS, FWS, BLM, USFS, not in effect on December 3, 1980.

Oppose all federal actions (RMPs, ACECs, PLOs, etc.) that have cumulative effect of closing Alaska lands to resource development and/or multiple use.Revise recent restrictive land management plans and related decisions that unnecessarily restrict mineral exploration and access.

Exempt the Tongass National Forest from the Roadless Rule. Prohibit use of USFS Forest Plan amendments that close or restrict Alaska National Forest lands to resource development or multiple use.

Water Policy

Require all actions, including Clean Water Act regulations, comply with the Sackett decision.

Manage wetlands through flexible mitigation programs tailored to Alaska's unique environment.

Streamline process for EPA approval of State water quality standards proposals, including adoption of scientifically-supportable water quality standards developed using site-specific criteria in permitting decisions.

Encourage the Environmental Protection Agency to complete timely, meaningful, and constructive comments when replying to USACE on Alaska Clean Water Act Section 404 Public Notices.

Exercise any vetoes within 90 days of the issuance of a Record of Decision. Seek legislation to reduce the time during which EPA can issue a Clean Water Act Section 404c veto to a short period of time after the Corps of Engineers issues a Record of Decision.

ALASKA MINERS ASSOCIATION

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Permitting and Land Management Principles

- Limit ESA listings and critical habitat designations to those with established and rigorous scientific justification and complete cost-benefit analyses.
- Rescind BLM's Conservation and Landscape Health rule.
- Finalize land conveyances to the State of Alaska and Alaska Native Corporations and rescind all federal withdrawals and public land orders established by the Secretary of Interior under ANCSA §17 (d)(1) and ANILCA.
- Reauthorize the Alaska Land Use Council.
- Require evaluation of the mineral potential in any area subject to federal land use planning. Require USGS to fulfill its ANILCA mineral reporting and assessment mandates.
- Reinstate USACE's Appendix C procedures relating to NHPA Section 106.
- Ensure transboundary mining issues are addressed through cooperation between the State of Alaska and neighboring Canadian provincial and territorial governments.
- Ensure federal agencies engage in land and resource management planning and decision making consistent with ANILCA, including prohibiting the designation of wilderness-like lands and similar withdrawals of lands or waters within and surrounding Alaska.
- Amend Title XI to require the recommendation of transportation and utility systems, including roads and infrastructure corridors, to the President and facilitates the issuance of authorizations and rights of way.

APPENDIX D: ALASKA MINERS ASSOCIATION – 2025 STATE ISSUES OF CONCERN FOR THE ALASKA MINING INDUSTRY

ALASKA MINERS ASSOCIATION

121 W. Fireweed Suite 120 | Anchorage, Alaska | 99503 | 907.563.9229 | alaskaminers.org

2025 STATE ISSUES OF CONCERN FOR THE ALASKA MINING INDUSTRY

Alaska's Permitting System

- Promote and defend Alaska's stringent permitting process to demonstrate that Alaska is open for business and is a key location to grow America's domestic mining industry.
- Adequately resource State regulatory agencies to attract and retain qualified personnel with the expertise to efficiently and durably permit large resource projects that will grow Alaska's economy.
- Reinforce and promote the mission of the Office of Project Management and Permitting to manage and streamline permitting activity for large projects.

Water Policy

- Require that Alaska's Water Quality Standards are scientifically supportable and developed using site-specific criteria, with ongoing evaluation as needed.
- Support Legislation and Administrative policy that requires designation of Tier 3 waters can only be made by a vote of the Legislature.
- Require that instream flow reservations are held only by the state.
- Support funding for State primacy over the CWA Section 404 permitting program and ADEC administration of the program concerning the fill of State 404 waters and wetlands in Alaska.
- Closely monitor EPA and USACE post-Sackett actions, and work to define adjacent wetlands in Alaska by limiting jurisdictional waters to only those with a continuous surface connection to a traditionally navigable water or tributary.
- Demand a consistent and practicable statewide CWA 404 Compensatory Mitigation policy following the fundamentals agreed to the 2018 Memorandum of Agreement signed by USACE and EPA.
- Create a clear, simple process for Alaskans to know if waters are within state or federal jurisdiction.
- Coordinate with federal regulatory agencies over permitting, mitigation, and management so that projects have access to reasonable and workable wetlands mitigation tools.

Fiscal Policy

Implement a comprehensive, long-term fiscal plan that ensures sustainable spending levels using budget reductions, use of Permanent Fund earnings, new revenues from broad-based sources, and strategies to grow a strong private sector.

Equitable Local Taxation

Reserve the authority to levy metal mining severance taxes solely to the Legislature.

Ballot Initiative Reform

- Support legislation, or a Constitutional amendment to reform the ballot initiative process, including measures that would nullify a ballot initiative if a court finds any portion to be unconstitutional.
- Prevent management of Alaska's natural resources outside of the regulatory process.

Funding Disclosure for Nonprofit Advocacy

Enact legislation to require disclosure when funds from nonprofit organizations are used to affect natural resource policy, permitting, litigation, and initiative proposals.

ALASKA MINERS ASSOCIATION

Land and Mineral Management

- Oppose all proposed policies that are designed to elevate one resource over another and recognize that Alaska mining projects successfully co-exist with the natural environment and other industries.
- Improve the status of Alaska's baseline mapping and collect resource data, such as airborne geophysical mapping as a means for increasing future State revenues.
- Pursue and defend guaranteed access, including RS2477s, for all uses across all state and federal lands.
- Require a thorough evaluation of mineral potential and access prior to any land allocations such as parks, preserves, or land disposals.
- Ensure the Trust Land Office meets its obligation to develop the mining lands (including the conversion of federal mining claim inholdings to Trust land) specifically transferred to the Alaska Mental Health Trust pursuant to the 1994 settlement of the Alaska Mental Health Trust Case to support Trust beneficiaries.

Support Alaska Statehood Defense efforts

- Oppose any federal encroachment on States' rights, such as the use of preemptive federal veto actions and imposition of excessive permitting requirements.
- Oppose the return of State lands/mineral rights to the federal government.
- Oppose unwarranted Endangered Species Act listings and critical habitat designations in Alaska and insist all decisions are based on sound science.
- Demand that ANCSA Native Corporations are recognized in federal government-to-government consultations.
- Pursue federal actions to rescind Public Land Orders issued under ANCSA Section 17(d)(1) where such actions would not harm the statutory right of Alaska Native Corporations to select and receive conveyance of the federal lands that they were promised in ANCSA.
- Ensure that neither the review process for placing tribal lands into trust, nor the final designation of a parcel as trust land, results in any temporary or permanent restrictions on access to, and development of, resources on adjacent lands.
- Pursue Federal Secretarial Orders lifting ANCSA § 17 (d)(1) and other Public Land Orders, while supporting protection of the interests of Alaska Natives in their ANCSA land selections and entitlements.
- Support exemption of the Tongass National Forest from the 2001 Roadless Rule.

Mining Education and Training

- Maintain a highly trained Alaskan workforce through support of all mining and geology related degree and occupational certificate programs in the UA system, including the UAF College of Engineering and Mines, the Mining and Petroleum Training Service, UAS Center for Mine Training, and the Prince William Sound College Millwright Program.
- Support University of Alaska efforts for the Alaska Critical Mineral Collaborative and endorsement of the application for a $160M NSF Regional Innovation program to establish the Alaska Critical Minerals Accelerator.
- Provide State of Alaska support for Alaska Resource Education to educate an upcoming workforce about natural resource industry careers.

Statewide Policy Impacts

- Support infrastructure projects that leverage responsible resource development to sustain and grow the State's economy.
- Ensure that public infrastructure is open to all users and maintenance comes from public revenue or broad-based funding sources.
- Support continued successful collaboration between the State of Alaska and our Canadian neighbors on responsible resource development within the transboundary region.

APPENDIX E: IDENTIFIED MINERAL RESOURCES OF ALASKA DEPOSITS

Modified from Szumigala (2024)

DEPOSIT—Type—Metal Suite PHASE	CATEGORY	SHORT TONS OF RESOURCE	Au gpt	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces
SHUMAGIN (UNGA PROJECT)— Epithermal — Precious metals (gold, silver) Source: Redstar Gold Corp. news release dated February 10, 2020							
Exploration (3.5 g/t cut-off)	Inferred	954,617	13.80	0.403	384.3	1.034	986.3
CENTENNIAL (UNGA PROJECT)— Epithermal — Precious metals (gold, silver) Source: Historical resource estimate by Battle Mountain Gold Company (1989), cited in Redstar Resources technical report on the Unga							
Exploration	Inferred	4,780,000	0.09	0.042	200.0		
KENSINGTON — Gold veins — Precious metals (gold) Source: Coeur Reports Year-End 2024 Mineral Reserves and Resources: Coeur Mining Annual Report dated February 19, 2025							
Production	Proven	1,340,000		0.186	249.0		
Production	Probable	1,427,000		0.177	252.0		
Production	Measured	2,150,000		0.254	546.0		
Production	Indicated	1,450,000		0.235	340.0		
Advanced Exploration	Inferred	993,000		0.229	228.0		
	Total	**7,360,000**		**0.151**	**1,114.0**		
LMS — Gold veins — Precious metals (gold) Source: NI 43-101 Technical Report on the LMS Gold Project, Goodpaster Mining District, Alaska; 43-101 technical report dated February 19, 2016							
Exploration (0.5 g/t Au cut-off, open pit)	Inferred	9,170,000	1.00	0.029	267.0		
POGO — Gold veins — Precious metals (gold) Source: Northern Star Resources Limited 2025 annual report dated August 21, 2025							
Production (as of March 31, 2025)	Proven	401,241	8.7	0.254	102		
Production (as of March 31, 2025)	Probable	9,662,849	7.20	0.210	2,024		
Production (as of March 31, 2025)	Measured	137,789	11.60	0.339	47		
Production (as of March 31, 2025)	Indicated	10,507,219	10.30	0.301	3,152		
Production (as of March 31, 2025)	Inferred	9,267,120	9.80	0.286	2,965		
	Total	**29,976,218**		**0.195**	**6,164**		
TERRA — Gold veins — Precious metals (gold, silver) Source: Technical Report on Resources, Terra Gold Project, McGrath District, Alaska; 43-101 technical report dated February 19, 2013							
Exploration (5 g/tonne Au cut-off)	Indicated	128,913	13.24	0.386	49.8	0.87	112.7
Exploration (5 g/tonne Au cut-off)	Inferred	811,286	15.63	0.456	369.8	0.81	653.9
	Total	**940,199**		**0.446**	**419.6**	**0.82**	**766.6**
NEW AMALGA (HERBERT GOLD) — Gold veins — Precious metals (gold) Source: Grande Portage Resources Ltd. news release dated June 12, 2024							
Exploration (2.5 g/tonne Au cut-off)	Indicated	5,209,517	9.47	0.277	1,438.5	0.17	891.0
Exploration (2.5 g/tonne Au cut-off)	Inferred	1,998,488	8.85	0.258	515.7	0.20	390.6
Exploration (2.5 g/tonne Au cut-off)	**Total**	**7,208,005**		**0.272**	**1,954.2**	**0.18**	**1,281.6**
GOLDEN ZONE — Gold veins — Precious metals (gold, silver) Source: Technical Report on the Golden Zone Property, Valdez Creek Mining District, Central Alaska Range, South-Central Alaska; NI 43-101 technical rep							
Exploration (0.5 g/tonne Au cut-off)	Indicated	4,615,377	13.24	0.058	267.4	0.303	1,397.8
Exploration (0.5 g/tonne Au cut-off)	Inferred	1,491,427	15.63	0.024	35.9	0.075	111.4
	Total	**6,106,804**		**0.050**	**303.3**	**0.247**	**1,509.2**
LUCKY SHOT — Gold veins — Precious metals (gold) Source:Technical Report Summary onr the Lucky Shot Project, Alaska, USA; NI 43-101 technical report dated May 26, 2023							
None	Proven						
None	Probable						
Exploration	Measured						
Exploration	Indicated	250,184	14.50	0.423	105.6		
Exploration	Inferred	90,453	9.50	0.277	25.1		
Exploration	**Total (resources only)**	**340,637**		**0.385**	**130.7**	**0.000**	**0.0**
SHOTGUN — Gold veins — Precious metals (gold) Source: Technical Report on the Shotgun Gold Project, Southwest Alaska; NI 43-101 technical report dated May 27, 2013							
Exploration (0.015 ounce of Au/ton cut-off)	Inferred	22,860,000	15.63	0.031	706.0		
	Total	**22,860,000**		**0.031**	**706.0**		
DONLIN — Intrusion gold — Precious metals (gold) Source: NovaGold Resources, Inc. Donlin Creek Gold Project, Alaska, USA, NI 43-101 Technical Report; effective date June 1, 2021; NovaGold Resources Inc. Annua							
Development	Proven	8,468,971	2.32	0.068	573.0		
Development	Probable	547,984,194	2.08	0.061	33,276.0		
Development	Measured	957,638.000	2.52	0.065	62.0		
Development	Indicated	76,481,004	2.24	0.071	5,497.0		
Development	Inferred	101,649,697	2.02	0.059	5,993.0		
	Total	**735,541,504**	**2.092**	**0.062**	**45,401.0**		

DEPOSIT—Type—Metal Suite	PHASE	CATEGORY	SHORT TONS OF RESOURCE	Au gpt	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Recoverable %
FORT KNOX — Intrusion gold — Precious metals (gold) Source: Kinross Gold Corp. annual report dated February 10, 2025									
	Production	Proven	401,241	1.20	0.035	275			
	Production	Probable	113,419,983	0.40	0.012	1,660			
	Production	Measured	0	0.00	0.000	-			
	Production	Indicated	74,888,737	0.40	0.012	1,032			
	Production	Inferred	16,758,419	0.40	0.012	273			
		Total	**205,468,379**	**0.402**	**0.012**	**3,240**			
GIL — Intrusion gold — Precious metals (gold) Source: Fort Knox Mine, Fairbanks North Star Borough, Alaska, USA; NI 43-101 technical report dated June 11, 2018; effective date: December 31, 2017									
	Production	Indicated							
	Production	Inferred							
		Total							
GOLDEN SUMMIT — Intrusion gold – Precious metals (gold) Source: Golden Summit Project Preliminary Economic Assessment, Fairbanks North Star Borough, Alaska, USA; 43-101 technical report dated January 20, 2016									
	Exploration (Dolphin oxide deposit; 0.30 g/tonne cut-off)	Indicated	17,835,214	0.66	0.019	345.0			
	Exploration (Dolphin oxide deposit; 0.30 g/tonne cut-off)	Inferred	10,604,126	0.60	0.017	183.0			
	Exploration (Dolphin sulfide deposit; 0.30 g/tonne cut-off)	Indicated	49,912,144	0.65	0.020	1,018.0			
	Exploration (Dolphin sulfide deposit; 0.30 g/tonne cut-off)	Inferred	68,210,324	0.61	0.020	1,401.0			
		Total	**146,561,808**	**0.62**	**0.020**	**2,947.0**			
GRANT MINE (Ester Dome) - Intrusion gold - Precious metals (gold) Source: Felix Gold Ltd., https://felixgold.investorportal.com.au/mineral-resources/ ; Conforms to JORC Code 2012, Effective date June 30, 2021									
	Exploration	Open Pit	5,647,530	1.38	0.040	227.9			
		Underground	751,895	6.20	0.181	136.1			
		Total	**6,399,424**	1.95	**0.057**	**364.0**			
MANH CHOH — Main and North Peak Skarn — Precious metals (gold, silver, {copper}) Source: Kinross Gold Corp. annual report dated February 10, 2025. **NOTE - converts Kinross 70% to 100%**									
	Production	Proven	483,306	6.40	0.187	90,320.2	0.289	139.7	140.0
	Production	Probable	3,165,889	7.70	0.225	711,818.4	0.415	1,312.7	1308.6
	Production	Measured	0	0.00	0.000	0.0	0.000	0.0	0.0
	Production	Indicated	404,591	2.70	0.079	31,898.0	0.304	122.9	122.9
	Production	Inferred	0	3.20	0.093	0.0	1.337	0.0	1.4
		Total	**4,053,786**	**7.05**	**0.183**	**743,716.4**	**0.354**	**1,435.6**	**1,432.9**
MONEY KNOB (Livengood) — Intrusion gold — Precious metals (gold) Source: Pre-Feasibility Study of the Livengood Gold Project, Livengood, Alaska, USA; 43-101 technical report dated December 17, 2021									
	Advanced Exploration	Proven	453,473,000	0.69	0.019	8,492.0			
	Advanced Exploration	Probable	20,387,000	0.70	0.025	512.0			
	Advanced Exploration	Measured	711,892,000	0.61	0.018	12,482.5			
	Advanced Exploration	Indicated	64,478,020	0.56	0.018	1,141.6			
	Advanced Exploration	Inferred	17,609,960	0.52	0.012	207.0			
		Total	**793,979,980**	**0.62**	**0.017**	**13,831.1**			
NIXON FORK — Intrusion gold (skarn) — Precious metals (gold) Source: Technical Report on the Nixon Fork Mine Project, Medfra Quadrangle, Alaska; NI 43-101 technical report dated February 3, 2012									
	Development (past producer; lode, 5 g/tonne cut-off)	Indicated	270,427	16.48	0.481	130.0			
	Development (past producer; lode, 5 g/tonne cut-off)	Inferred	118,200	17.55	0.512	60.5			
	Development (past producer; tailings, 5 g/tonne cut-off)	Indicated	101,412		0.230	23.3			
	Development (past producer; tailings, 5 g/tonne cut-off)	Inferred	52,910		0.210	11.4			
		Total	**542,949**	**16.81**	**0.414**	**225.2**			
VINASALE — Intrusion gold — Precious metals (gold) Source: Technical Report for the Vinasale Mountain Prospect, McGrath Mining District, Alaska; 43-101 technical report dated March 31, 2013									
	Exploration	Indicated	3,760,000	1.48	0.043	162.0			
	Exploration	Inferred	55,340,000	1.06	0.031	1,703.0			
		Total	**59,100,000**	**1.09**	**0.032**	**1,865.0**			
ILLINIOS CREEK — Intrusion gold-silver-copper — Precious metals (gold, silver) Source: Western Alaska Minerals Corp.: NI 43-101 Technical Report Illinois Creek Project Update, Illinois Creek Mining District, Western Alaska, USA, d									
	Advanced Exploration	Indicated	9,587,400	0.90	0.026	253.0	1.004	9,600	
	Advanced Exploration	Inferred	3,636,600	0.99	0.029	104.0	1.057	4,800	
		Total	**13,224,000**	**0.925**	**0.027**	**357.0**	**1.019**	**14,400**	

DEPOSIT—Type—Metal Suite PHASE	CATEGORY	SHORT TONS OF RESOURCE	Au gpt	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces
NAOSI — Intrusion gold — Precious metals (gold) Source: Internal resource calculation presented to the American Exploration and Mining Association annual meeting, December 2019.							
Exploration Oxide (0.0102 oz/ton cut-off)	Indicated	11,697,714		0.049	576.0	0.79	9,274
Exploration Sulfide (0.0146 oz/ton cut-off)	Indicated	6,715,193		0.063	421.0	0.82	5,498
Exploration Oxide (0.0102 oz/ton cut-off)	Inferred	9,307,906		0.030	277.0	0.41	3,852
Exploration Sulfide (0.0146 oz/ton cut-off)	Inferred	2,200,211		0.035	75.0	0.65	1,419
Exploration Mon Ridge and Lone Wolf (0.0102 oz/ton cut-off)	Inferred	5,173,141		0.043	222.0	0.39	2,027
	Total	**35,094,165**		**0.042**	**1,571**	**0.65**	**22,070**
KORBEL — Intrusion gold — Precious metals (gold) Source: Nova Minerals Ltd. S-K 1300 Initial Assessment Technical Report Summary on the Estelle Gold Project, Alaska, USA, dated January 31, 2024							
Exploration (0.15 g/t cut-off, Korbel Main)	Indicated	264,554,400	0.30	0.009	2,390.0		
Exploration (0.15 g/t cut-off, Korbel Main)	Inferred	38,580,850	0.30	0.009	300.0		
Exploration (0.15 g/t cut-off, Cathedral)	Inferred	165,346,500	0.30	0.009	1,350.0		
Exploration (0.20 g/t cut-off, RPM North)	Measured	1,543,234	4.10	0.120	180.0		
Exploration (0.20 g/t cut-off, RPM North)	Indicated	3,306,930	1.60	0.047	150.0		
Exploration (0.20 g/t cut-off, RPM North)	Inferred	25,353,130	0.60	0.018	450.0		
Exploration (0.20 g/t cut-off, RPM South)	Inferred	25,353,130	0.50	0.015	350.0		
	Total	**524,038,174**		**0.010**	**5,170**		

DEPOSIT—Type—Metal Suite PHASE	CATEGORY	TONS OF RESOURCE	Cu %	Cu thousand pounds	Cu tonnes	Pb %	Pb thousand pounds	Pb Tonnes	Zn %	Zn thousand pounds	Zn tonnes	Recover-able %	Au gpt	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces
DELTA — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Bedrock Geologic Map of the Delta Mineral Belt, Tok Mining District, Alaska (DGGS PR 122); 2003																	
Exploration (DW/Mid/Nunatak/LP)	Inferred	9,400,000	0.4	75,200	34,110	1.75	329,000	149,233	4.61	866,680	393,123		1.61	0.047	441.9	1.85	17,402
Exploration (PP2)	Inferred	5,900,000	0.4	47,200	21,410	2.1	247,800	112,401	4.6	542,800	246,212		1.70	0.050	292.9	2.07	12,232
Exploration (DDS)	Inferred	2,300,000	1.1	50,600	22,952	2.6	119,600	54,250	6.5	299,000	135,626		2.40	0.070	161.2	2.98	6,850
Exploration (DDN)	Inferred	1,200,000	1.6	38,400	17,418	2.4	57,600	26,127	2.3	55,200	25,039		3.20	0.093	112.1	2.98	3,574
	Total	**18,800,000**	**0.6**	**211,400**	**95,890**	**1.9**	**754,000**	**342,012**	**4.5**	**1,763,680**	**800,000**		**1.60**	**0.048**	**1,008.1**	**1.96**	**40,058**
RED MOUNTAIN/BONNIFIELD — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source:Silver47 Exploration Corp. Technical Report on the Red Mountain VMS Property, Bonnifield Mining District, Alaska, USA, dated June 28, 2024																	
Exploration (Dry Creek; Open-Pit, 1% Zn cut-off)	Inferred	8,485,400	0.22	37,479	17,000	1.05	178,574	81,000	2.73	462,970	210,000		0.34	0.010	85	1.314	11,200
Exploration (West Tundra Flats; Open-Pit, 1% Zn cut-off)	Inferred	2,755,000	0.09	4,409	2,000	2.49	138,891	63,000	5.09	282,191	128,000		0.79	0.023	64	4.821	13,400
Exploration (Dry Creek; Underground, 3% Zn cut-off)	Inferred	4,297,800	0.15	13,228	6,000	1.28	108,026	49,000	3.50	297,624	135,000		0.35	0.010	43	1.489	6,300
Exploration (West Tundra Flats; Underground, 3% Zn cut-off)	Inferred	1,653,000	0.07	2,205	1,000	1.53	50,706	23,000	3.79	127,868	58,000		0.46	0.013	22	2.961	5,000
	Total	**17,191,200**	**0.17**	**57,320**	**26,000**	**1.38**	**476,198**	**216,000**	**3.40**	**1,170,653**	**531,000**		**0.43**	**0.006**	**214**	**2.078**	**35,900**
GREENS CREEK — Massive sulfide — Polymetallic (lead, zinc, gold, silver) Source: Hecla Mining Company 2024 Annual Report																	
Production	Proven	9,000				2.4	440		6.5	1,200				0.07	1.0	7.6	70
Production	Probable	10,438,000				2.3	480,900		6.2	1,292,020				0.08	864.0	9.9	103,641
Production	Measured	0															
Production	Indicated	7,619,000				3.0	454,720		8.0	1,351,480				0.10	760.0	14.1	107,226
Production	Inferred	1,878,000				2.9	108,020		6.9	1,215,200				0.08	151.0	13.4	25,106
	Total	**19,944,000**				**2.6**	**1,044,080**		**7.0**	**3,859,900**				**0.09**	**1,776.0**	**11.8**	**236,043**
NIBLACK — Massive sulfide — Polymetallic (copper, zinc, gold, silver) Source: NexGold website, Niblack Polymetallic Sulfide Project, minerl resource dated February 2023 https://nexgold.com/niblack/																	
Advanced Exploration (Lookout deposit)	Indicated	5,940,882	0.92	108,900					1.72	204,900			1.88	0.055	326.6	0.876	5,165
Advanced Exploration (Lookout deposit)	Inferred	175,218	0.93	3,300					1.31	4,600			1.63	0.048	8.3	0.526	93
Advanced Exploration (Trio deposit)	Indicated	506,920	1.16	11,800					1.75	17,700			1.30	0.038	19.2	0.584	294
Advanced Exploration (Trio deposit)	Inferred	60,610	0.91	1,100					1.61	1,900			1.20	0.035	2.1	0.526	32
	Total	**6,683,630**	**0.94**	**125,100**					**1.71**	**229,100**			**1.82**	**0.049**	**356**	**0.841**	**5,584**
PALMER — Massive sulfide — Polymetallic (copper, zinc, gold, silver) Source: NI 43-101 Technical Report Mineral Resource Estimate Palmer Project, Alaska, USA; effective date: January 13, 2025.																	
Exploration South Wall Zone 1	Indicated	3,030,500	2.15	130,200		0.11	6,600		5.20	315,400			0.33	0.010	28.8	0.750	2,275
Exploration (South Wall Zone 2)	Indicated	2,226,040	1.08	47,900		0.17	7,700		5.12	227,600			0.23	0.007	15.1	0.937	2,078
Exploration (RW)	Inferred	1,851,360	0.71	26,200		0.47	17,800		3.50	129,900			0.31	0.009	16.9	1.358	2,516
Exploration (South Wall Zone 1)	Inferred	1,432,600	1.79	51,000		0.18	5,100		4.93	140,800			0.39	0.011	16.4	1.004	1,432
Exploration (South Wall Zone 2)	Inferred	980,780	0.87	17,200		0.15	2,900		4.32	85,000			0.20	0.006	5.9	0.765	754
Exploration (South Wall Zone 3)	Inferred	3,063,560	0.65	39,500		0.09	5,400		3.84	222,700			0.21	0.006	18.9	0.619	1,895
Exploration (AG (JAG))	Inferred	5,653,260	0.15	16,800		0.83	93,300		4.04	456,700			0.40	0.012	66.0	2.824	15,942
Exploration (AG Zone (Nunatak))	Inferred	242,440	0.16	800		0.20	1,000		0.25	1,200			0.57	0.017	4.0	12.693	3,049
	Total	**18,480,540**	**0.89**	**329,600**		**0.38**	**139,800**		**4.31**	**1,579,300**				**0.009**	**172**	**1.623**	**29,941**
JOHNSON TRACT — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Updated Mineral Resource Estimate and NI 43-101 Technical Report for the Johnson Tract Project, Alaska; 43-101 technical report dated August 25, 2022.																	
Exploration (3.0 g/t gold-equivalent cutoff)	Indicated	384,595,959	0.56	43,100		0.67	51,500		5.21	400,800				0.156	598.0	0.18	673
Exploration (3.0 g/t gold-equivalent cutoff)	Inferred	778,231	0.59	9,200		0.30	4,700		4.18	65,100				0.040	31.0	0.27	207
	Total	**385,374,190**	**0.56**	**52,300**		**0.67**	**56,200**		**5.21**	**465,900**				**0.155**	**629.0**	**0.18**	**880**
RED DOG — Massive sulfide — Base metals (lead, zinc, silver) Source: Reserves and resouces as of December 31, 2024. 2024 Annual Information Form https://www.teck.com/media/AIF-2025.pdf, accessed on November 21, 2025																	
Production (Aqqaluk, Qanaiyaq)	Probable	32,077,221				3.3	1,102,310		11.5	6,217,028		81				1.80	36,130
Production (Aqqaluk, Qanaiyaq)	Indicated	5,180,857				6.4	663,150		7.9	818,575						3.64	18,834
Production (Aqqaluk, Qanaiyaq)	Inferred	14,550,492				4.2	1,222,241		11.1	3,230,209						2.27	33,098
	Total	**51,808,570**				**3.9**	**2,987,701**		**11.0**	**10,265,813**						**2.12**	**88,062**

DEPOSIT—Type—Metal Suite PHASE	CATEGORY	SHORT TONS OF RESOURCE	Cu %	Cu thousand pounds	Cu tonnes	Pb %	Pb thousand pounds	Pb Tonnes	Zn %	Zn thousand pounds	Zn tonnes	Recover-able %	Au gpt	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces
RED DOG — Massive sulfide — Base metals (lead, zinc, silver) Source: Reserves and resouces as of December 31, 2024. 2024 Annual Information Form https://www.teck.com/media/AIF-2025.pdf, accessed on November 21, 2025																	
Production (Aqqaluk, Qanaiyaq)	Probable	32,077,221				3.3	1,102,310		11.5	6,217,028		81				1.80	36,130
Production (Aqqaluk, Qanaiyaq)	Indicated	5,180,857				6.4	663,150		7.9	818,575						3.64	18,834
Production (Aqqaluk, Qanaiyaq)	Inferred	14,550,492				4.2	1,222,241		11.1	3,230,209						2.27	33,098
	Total	**51,808,570**				**3.9**	**2,987,701**		**11.0**	**10,265,813**						**2.12**	**88,062**
AKTIGIRUQ — Massive sulfide — Base metals (lead, zinc, silver) Source: Reserves and resouces as of December 31, 2024. 2024 Annual Information Form https://www.teck.com/media/AIF-2025.pdf, accessed on November 21, 2025																	
Exploration	Indicated	36,045,537				4.2	3,027,825		16.2	11,678,754						2	77,256
Exploration	Inferred	29,321,446				3.5	2,052,501		13.7	8,034,076							
	Total	**65,366,983**				**3.9**	**5,080,326**		**15.1**	**19,712,830**						**1**	**77,256**
ANARRAAQ — Massive sulfide — Base metals (lead, zinc, silver) Source: Reserves and resouces as of December 31, 2024. 2024 Annual Information Form https://www.teck.com/media/AIF-2025.pdf, accessed on November 21, 2025																	
Exploration	Inferred	17,967,653				4.0	1,437,412	826,000	14.3	5,138,749						2.35	42,182
ANARRAAQ — Bedded Barite: Source: King et al., 2002, A summary of ongoing research in the Red Dog district and possible applications to exploration, in Large et al., eds.: Stratiform Zn-Pb-Ag Deposits and Geological Environments, with Emphasis on the Aust. and N. Am. Giants: SEG/PDAC Workshop, Toronto, 2002, 6 p.																	
Exploration (barite grade unspecified)	Inferred	1,100,000,000															
LIK — Massive sulfide — Base metals (lead, zinc, silver) Source: S-K 1300 Technical Report Summary, Lik Project, Northwest Arctic Borough, Alaska, USA, Solitario Zinc Corp.; dated March 11, 2022																	
Advanced Exploration (Lik South, 5% Zn+Pb cut-off)	Indicated	18,849,501				2.69	1,014,103	459,990.00	8.04	3,031,000	1,374,840.00					1.46	27,520
Advanced Exploration (Lik North, 5% Zn+Pb cut-off)	Indicated	562,178				2.46	27,659	12,546.00	8.95	100,630	44,000.00					1.54	868
Advanced Exploration (Lik South, 5% Zn+Pb cut-off)	Inferred	782,640				1.97	30,836	13,987.00	7.78	121,779	57,000.00					0.42	327
Advanced Exploration (Lik North, 5% Zn+Pb cut-off)	Inferred	2,303,828				2.98	137,308	62,282.00	8.93	411,464	189,000.00					1.38	3,175
	Total	**22,498,147**				**2.69**	**1,209,906**	**548,805**	**8.14**	**3,664,872**	**1,664,840**					**1.42**	**31,891**
ARCTIC — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Arctic NI 43-101 Technical Report on Feasibility Study, dated February 14, 2023																	
Advanced Exploration	Indicated	39,352,467	2.98	2,347,000		0.79	621,000		4.09	3,216,000			0.59	0.017	675.0	1.32	52,000
Advanced Exploration	Inferred	4,960,395	1.92	189,000		0.70	69,000		2.93	288,000			0.43	0.013	62.0	1.04	5,000
	Total	**44,312,862**	**2.86**	**2,536,000**		**0.78**	**690,000**		**3.96**	**3,504,000**			**1.32**	**0.017**	**737.0**	**1.29**	**57,000**
BORNITE — Massive sulfide — Polymetallic (carbonate-hosted copper, cobalt) Source: NI 43-101 Technical Report on the Preliminary Economic Assessment of the Bornite Project, Northwest Alaska, USA; report dated January 15, 2025 https://trilogymetals.com/site/assets/files/6458/trilogy_-_bornite_ni_43-101_technical_report.pdf																	
Exploration (in pit, 0.5% Cu cut-off)	Inferred	187,833,624	1.15	4,303,000													
Exploration (outside pit, South Reef, 1.45% Cu cut-off)	Inferred	30,313,525	2.78	1,687,000													
Exploration (Outside- pit Ruby Zone, 1.79% Cu cut-off)	Inferred	11,464,024	2.28	521,000													
Exploration (Underground Development, 0.70% Cu cut-off)	Inferred	1,080,264	0.98	16,000													
	Total	**230,691,437**	**1.05**	**6,364,000**													
SUN — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: SolidusGold Inc. technical report dated May 13, 2022																	
Exploration ($75/tonne cut-off)	Indicated	1,888,257	1.48	55,846		1.11	42,035		4.32	162,962				0.006	12.0	1.75	3,307
Exploration ($75/tonne cut-off)	Inferred	9,940,632	1.21	239,643		1.46	290,258		4.18	831,334				0.007	73.0	2.39	23,681
	Total	**11,828,889**	**1.25**	**295,489**		**1.40**	**332,293**		**4.20**	**994,296**				**0.007**	**85**	**2.28**	**26,988**
SMUCKER — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Historical resource from Anaconda Copper Mining Company, Internal Report, 1981; cited in Trilogy Metals news release dated March 19, 2019.																	
Exploration	Inferred	12,786,796	0.95	242,949		2.3	588,193		6.4	1,636,710				0.025	324.8	4.78	61,084
HORSE CREEK — Massive sulfide — Polymetallic (copper, lead, zinc, silver) Source: Historical resource from Kennecott Mines Company, Internal Report, 1985; cited in Trilogy Metals news release dated March 19, 2019.																	
Exploration	Historic	11,000,000	1.00	220,000		2	440,000		3	660,000						0.91	9,957
SUNSHINE — Massive sulfide — Polymetallic (copper, lead, zinc, silver) Source: Historical resource from Kennecott Mines Company, Internal Report, 1997; cited in Trilogy Metals news release dated March 19, 2019.																	
Exploration	Historic	22,000,000	1.40	616,000		0.5	220,000		2.5	1,100,000						0.76	16,767
SHUNGNAK — Massive sulfide — Polymetallic (copper, zinc, silver) Source: Historical resource from Bear Creek Mining Company, Internal Report, 1983; cited in Trilogy Metals news release dated March 19, 2019.																	
Exploration	Historic	1,100,000	3.00	66,000					2	44,000						1.82	1,998
BT — Massive sulfide — Polymetallic (copper, lead, zinc, silver) Source: Historical resource from Kennecott Mines Company, Internal Report, 1997; cited in Trilogy Metals news release dated March 19, 2019.																	
Exploration	Historic	3,800,000	1.70	129,200		0.9	68,400		2.6	197,600						1.18	4,483
CARIBOU DOME — Sediment-hosted — Base metals (cpper) Source: PolarX Ltd. Resource increases 160% to 224,375t of contained Copper plus 1.5Moz Silver, news release dated June 13, 2023 https://wcsecure.weblink.com.au/pdf/PXX/02676076.pdf																	
Advanced Exploration (0.5% Cu cut-off)	Measured	1,102,310	3.9	87,744	39,800											0.25	284.0
Advanced Exploration (0.5% Cu cut-off)	Indicated	3,527,392	3.3	231,871	105,175											0.19	662.8
Advanced Exploration (0.5% Cu cut-off)	Inferred	3,306,930	2.6	175,047	79,400											0.17	552.0
	Total	**7,936,632**	**3.1**	**494,662**	**224,375**											**0.19**	**1,498.8**

DEPOSIT—Type—Metal Suite PHASE	CATEGORY	SHORT TONS OF RESOURCE	Cu %	Cu thousand pounds	Cu tonnes	Pb %	Pb thousand pounds	Pb Tonnes	Zn %	Zn thousand pounds	Zn tonnes	Recoverable %	Au gpt	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Recoverable %	Mo %	Mo thousand pounds
	Total	**7,936,632**	**3.1**	**494,662**	**224,375**											**0.19**	**1,498.8**			
PEBBLE — Porphyry — Polymetallic (copper, gold, silver, molybdenum) Source: 2023 PEA Technical Report on the Pebble Project, Southwest Alaska, USA; August 21, 2023 https://northerndynastyminerals.com/pebble-project/reserves-resources-1/																				
Advanced Exploration (0.3 CuEq cut-off), recoverable metal	Measured	580,917,370	0.33	3,350,000									0.35	0.010	5,930	0.05	20,400		0.0178	150,000
Advanced Exploration (0.3 CuEq cut-off), recoverable metal	Indicated	6,535,595,990	0.41	49,640,000									0.34	0.010	64,810	0.05	228,900		0.0246	2,620,000
Advanced Exploration (0.3 CuEq cut-off), recoverable metal	Inferred	4,909,688,740	0.25	22,660,000									0.25	0.007	35,800	0.04	121,700		0.0226	1,810,000
	Total	**12,026,202,100**	**0.341**	**75,650,000**									**0.304**	**0.009**	**106,540**	**0.04**	**371,000**		**0.0235**	**4,580,000**
PYRAMID — Porphyry — Polymetallic (copper, gold, molybdenum) Source: NI 43-101 Technical Report for the Pyramid Project, Alaska Peninsula, Alaska; report dated January 2018																				
Main Zone (0.20% Cu-equivalent cut-off)	Inferred	155,315,479	0.38	1,186,000	373,310								0.09	0.003	442.0				0.022	68,000
West Zone (0.20% Cu-equivalent cut-off)	Inferred	13,778,875	0.28	76,000	233,602								0.08	0.002	14.0				0.010	2,000
	Total	**169,094,354**	**0.37**	**1,262,000**	**606,913**								**0.09**	**0.003**	**456.0**				**0.021**	**70,000**
RAINTREE WEST — Porphyry — Polymetallic (copper, gold, silver) Source: S-K 1300 Report titled "S-K 1300 Technical Report Summary Initial Assessment for the Whistler Project", Effective Date 12 September 2024 and Date of Issue 7 October 2024, https://www.sec.gov/ix?doc=/Archives/edgar/data/0001947244/000149315224039681/form8-k.htm																				
Exploration (Pit-constrained)	Indicated	9,816,071	0.08	16,000									0.46	0.013	131	0.14	1,378			
Exploration (Underground)	Indicated	3,377,478	0.13	9,000									0.79	0.023	78	0.13	443			
Exploration (Pit-constrained)	Inferred	16,596,379	0.06	21,000									0.55	0.016	267	0.13	2,112			
Exploration (Underground)	Inferred	44,568,598	0.12	103,000									0.76	0.022	994	0.10	4,300			
	Total	**74,358,526**	**0.10**	**149,000**									**0.67**	**0.018**	**1,470**	**0.11**	**8,233**			
ISLAND MOUNTAIN — Porphyry — Polymetallic (copper, gold, silver) Source: S-K 1300 Report titled "S-K 1300 Technical Report Summary Initial Assessment for the Whistler Project", Effective Date 12 September 2024 and Date of Issue 7 October 2024, https://www.sec.gov/ix?doc=/Archives/edgar/data/0001947244/000149315224039681/form8-k.htm																				
Exploration (Pit-constrained)	Inferred	137,269,562	0.05	139,000									0.45	0.013	1,817	0.03	4,084			
	Total	**137,269,562**	**0.05**	**139,000**	**0**						**0**	**0**	**0.45**	**0.013**	**1,817**	**0.03**	**4,084**			
WHISTLER — Porphyry — Polymetallic (copper, gold, silver) Source: S-K 1300 Report titled "S-K 1300 Technical Report Summary Initial Assessment for the Whistler Project", Effective Date 12 September 2024 and Date of Issue 7 October 2024, https://www.sec.gov/ix?doc=/Archives/edgar/data/0001947244/000149315224039681/form8-k.htm																				
Exploration (Pit-constrained; Whistler)	Indicated	311,077,394	0.16	999,000									0.68	0.020	3,724	0.06	17,166			
Exploration (Pit-constrained; Whistler)	Inferred	20,088,497	0.13	54,000									0.40	0.012	233	0.05	1,025			
	Total	**331,165,891**	**0.16**	**1,053,000**									**0.66**	**0.015**	**3,957**	**0.055**	**18,191**			
ZACKLY — Skarn — Polymetallic (copper, gold, silver) Source: JORC-compliant resource, PolarX news release (scoping study) dated October 17, 2022																				
Exploration	Indicated	2,755,775	1.2	68,000									1.90	0.055	155	0.405	1,120			
Exploration	Inferred	1,653,465	0.9	32,000									1.20	0.035	58	0.303	513			
	Total	**4,409,240**	**1.1**	**100,000**										**0.048**	**213**	**0.367**	**1,633**			
QUARTZ HILL — Porphyry — (Molybdenum) Source: Mineral investigations in the Ketchikan mining district, southeastern Alaska: U.S. Bureau of Mines Open-File Report 11-95 (1995)																				
Exploration	"Probable resource"	489,425,640																	0.131	1,285,182
Exploration	"Possible resource"	1,499,141,600																	0.082	2,444,643
	Total	**1,988,567,240**																	**0.094**	**3,729,826**
WATERPUMP CREEK — Carbonate Replacement— Polymetallic (silver, zinc, lead) Source: Western Alaska Minerals Corp.: NI 43-101 Technical Report Illinois Creek Project Update, Illinois Creek Mining District, Western Alaska, USA, dated February 20, 2024																				
Exploration	Inferred (Oxide)	793,440														4.8	3,500			
Exploration	Inferred (Sulfide)	2,622,760				9.87	517,300		11.28	591,200						8.15	21,400			
Exploration	**Total**	**3,416,200**					**517,300**			**591,200**							**24,900**			
BOKAN MOUNTAIN — Other (Intrusion hosted) — Other (rare-earth elements) Source: Ucore Increases Resource at Bokan Dotson-Ridge; Ucore Rare Metals news release May 11, 2015																				
Advanced Exploration (Dotson trend, 0.4% TREO cut-off)	Indicated	5,278,000																		
Advanced Exploration (Dotson trend, 0.4% TREO cut-off)	Inferred	1,157,000																		
	Total	**6,435,000**																		
GRAPHITE CREEK — Other (graphite) Source: Graphite One, Graphite Crek Project, NI 43-101 Technical Report and Feasibility Study, Seward Peninsula, Alaska, effective date March 25,2025, file:///C:/Users/djszumigala.SOA.000/Downloads/GraphiteOne_TechReport-1.pdf																			**Graphite (Tonnes)**	
Advanced Exploration (variable 2.0% - 3.0% Cg cut-off)	Proven	4,517,098																	238000	
Advanced Exploration (variable 2.0% - 3.0% Cg cut-off)	Probable	73,966,240																	3480000	
Exploration (2.0% Cg cut-off)	Measured	5,631,220																	272,249	
Exploration (2.0% Cg cut-off)	Indicated	109,726,140																	4,523,443	
Exploration (2.0% Cg cut-off)	Inferred	295,446,200																	11,567,844	
	Total	**489,286,898**																	**20,081,536**	
LAKEVIEW, LONGVIEW — Other (stratiform barite) Source: Schmidt and others, 2009, The Longview/Lakeview barite deposits, southern National Petroleum Reserve, Alaska; potential-field models and preliminary size estimates, U.S. Geological Survey Professional Paper 1760-C, 29 p. [http://pubs.usgs.gov/pp/1760/c/]																				
USGS geological/geophysical estimate (range 4.5-38.4 million metric tons; mid-range value: 18.4 million metric tons)	Inferred	20,200,000																		
LAKEVIEW, LONGVIEW — Other (stratiform barite) Source: Schmidt and others, 2009, The Longview/Lakeview barite deposits, southern National Petroleum Reserve, Alaska; potential-field models and preliminary size estimates, U.S. Geological Survey Professional Paper 1760-C, 29 p. [http://pubs.usgs.gov/pp/1760/c/]																		**Barite (%)**	**Thousands of pounds**	
USGS geological/geophysical estimate (range 4.5-38.4 million metric tons; mid-	Inferred	20,200,000																93	37,600,000	
BION — Other (stratiform barite) Source: Kelley and others, 1993, Barite deposits in the Howard Pass Quadrangle and possible relations to barite elsewhere in the northwestern Brooks Range, Alaska: U.S. Geological Survey Open-File Report 93-215, 13 p. [https://doi.org/10.3133/ofr93215]																		**Barite (%)**	**Thousands of pounds**	
USGS, USBM geological/geophysical estir	Inferred	11,079,331																?	?	

DEPOSIT—Type—Metal Suite PHASE	CATEGORY	SHORT TONS OF RESOURCE	Ni %	Ni thousand pounds	Ni tonnes	Cu %	Cu thousand pounds	Co %	Co thousand pounds	Recoverable %	Au gpt	Au oz/ton	Au thousand ounces	Pd oz/ton	Pd thousand ounces	Pt oz/ton	Pt thousand ounces	Cr %	Cr thousand pounds	Fe %	Fe thousand tons
NIKOLAI— Other (nickel-copper-platinum-group-element in mafic/ultramafic intrusion) Alaska Energy Metals Corp, Souce: Nikolai Mineral Resource Estimate Technical Report, 2025 Update Nikolai Nickel Project, Delta River Mining District, Alaska, USA; file:///C:/Users/djszumigala.SOA.000/Downloads/rpt_24777-0001_ni43101-mre-updt_0_FINAL.pdf , effective date March 7, 2025																					
Exploration EZ2	Indicated	901,436,000	0.22	4,009,000		0.08	1,378,000	0.02	312000		0.013	0.0004	349	0.102	2,679	0.047	1,237	0.31	5,546	9.9	81,000
Exploration EZ3	Indicated	106,894,000	0.16	331,000		0.02	47,000	0.02	33000		0.008	0.0002	24	0.018	57	0.030	94	0.43	910	10.1	9,700
Exploration EZ2	Indicated	232,522,000	0.20	944,000		0.07	314,000	0.02	76000		0.012	0.0004	84	0.080	547	0.046	314	0.21	991	9.8	21,000
Exploration EZ3	Indicated	69,426,000	0.23	321,000		0.02	26,000	0.02	21000		0.006	0.0002	11	0.024	48	0.036	73	0.31	433	9.5	6,000
Exploration EZ1	Inferred	318,478,000	0.16	997,000		0.02	106,000	0.02	101000		0.003	0.0001	32	0.015	136	0.022	203	0.21	1,361	9.6	1,899,000
Exploration EZ2	Inferred	1,048,002,000	0.22	2,012,000		0.07	1,478,000	0.02	352000		0.013	0.0004	396	0.095	2,906	0.042	1,280	0.28	5,957	9.7	8,855,000
Exploration EZ3	Inferred	189,544,000	0.16	593,000		0.02	79,000	0.02	58000		0.006	0.0002	36	0.018	99	0.029	159	0.41	1,549	10.0	1,310,000
Exploration EZ2	Inferred	600,590,000	0.22	2,594,000		0.06	717,000	0.02	205000		0.010	0.0003	175	0.076	1,324	0.045	792	0.21	2,563	10.2	4,812,000
Exploration EZ3	Inferred	141,056,000	0.23	646,000		0.02	53,000	0.02	43000		0.005	0.0001	21	0.023	93	0.035	143	0.30	860	9.4	1,109,000
	Total	**3,607,948,000**	**0.21**	**12,447,000**		**0.06**	**4,198,000**	**0.02**	**1,201,000**		**0.011**	**0.0003**	**1,128**	**0.075**	**7,889**	**0.041**	**4,295**	**0.28**	**3,876.9**	**9.843**	**18,102,700**
; effective date April 30, 2025																					
Exploration (0.3 g/t Au cut-off)	Indicated	34,103,672									1.03		1,126.785					Garnet	524 tons @ 10.24 kg/t		

Data in this table were collected from publicly available company reports, company press releases, and government publications.