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MBMG Montana Bureau of Mines and Geology

Critical Mineral: Zinc

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Overview

Zinc (Zn) is a chemical element that is included on the United States Geological Survey's 2022 Critical Minerals list. Zn is a grayish, slightly brittle metal that is used in a variety of applications. These include alloys (typically with copper to make brass), rust-proofing (galvanizing), dietary supplements, health products, and batteries.

The abundance of Zn makes it an attractive potential alternative to lithium (Li) for use in batteries that power most portable electronics. Li deposits are much rarer than Zn ones. Large scale Zn-air batteries in development for electric vehicles and power grid storage have the potential to be cheaper, less toxic, and less flammable than Li-ion batteries.

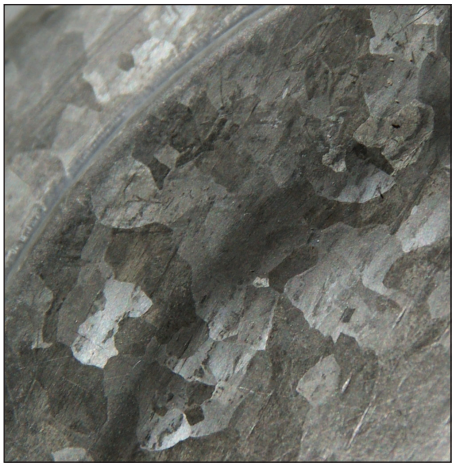

Figure 1. A thin coating of Zn crystals on another metal surface (galvanization). Photo by Hi-Res Images of Chemical Elements (CC-BY-3.0).

Figure 2. A 1.35 V Zn-air battery. These are commonly used to replace older and toxic mercury battery types. Photo by huzu1959 (CC-BY-2.0).

Supply

China, Peru, Australia, and India were the top Zn producers in 2022. The U.S. was a distant fifth with 770 kilotonnes (kt) of Zn produced in 2022. The U.S. also imported 700 kt in 2022.

Most Zn mining in the U.S. is from deposits in Tennessee and Alaska. Recycling also provides a significant proportion of refined Zn production. Domestic reserves of Zn are expected to last slightly less than 10 years at current production rates. Pricing for Zn in 2022 averaged $1.90/lb. Grades for Zn ore range from about 1% to over 10%.

Mineralogy

Zn is mined as sulfide (sphalerite, wurtzite), carbonate (smithsonite, hydrozincite), and silicate (hemimorphite) ores. Typically, carbonate and silicate Zn ore minerals are the products of sulfide ore weathering.

Most American Zn deposits are Mississippi Valley-Type. Other deposit types include skarns, sedimentary exhalative, stratiform sediment-hosted, carbonate-replacement, and polymetallic vein. Other critical minerals that can occur with Zn in these deposits are germanium (Ge), gallium (Ga), indium (In), bismuth (Bi), barite ($BaSO_4$), cobalt (Co), tellurium (Te), antimony (Sb), and arsenic (As).

Figure 3. Specimens of sphalerite from the Broadwater Mine, Cascade County, Montana (top) and smithsonite from the Elkhorn Mine, Jefferson County, Montana (bottom). Photos by Dr. Steven Quane, MBMG.

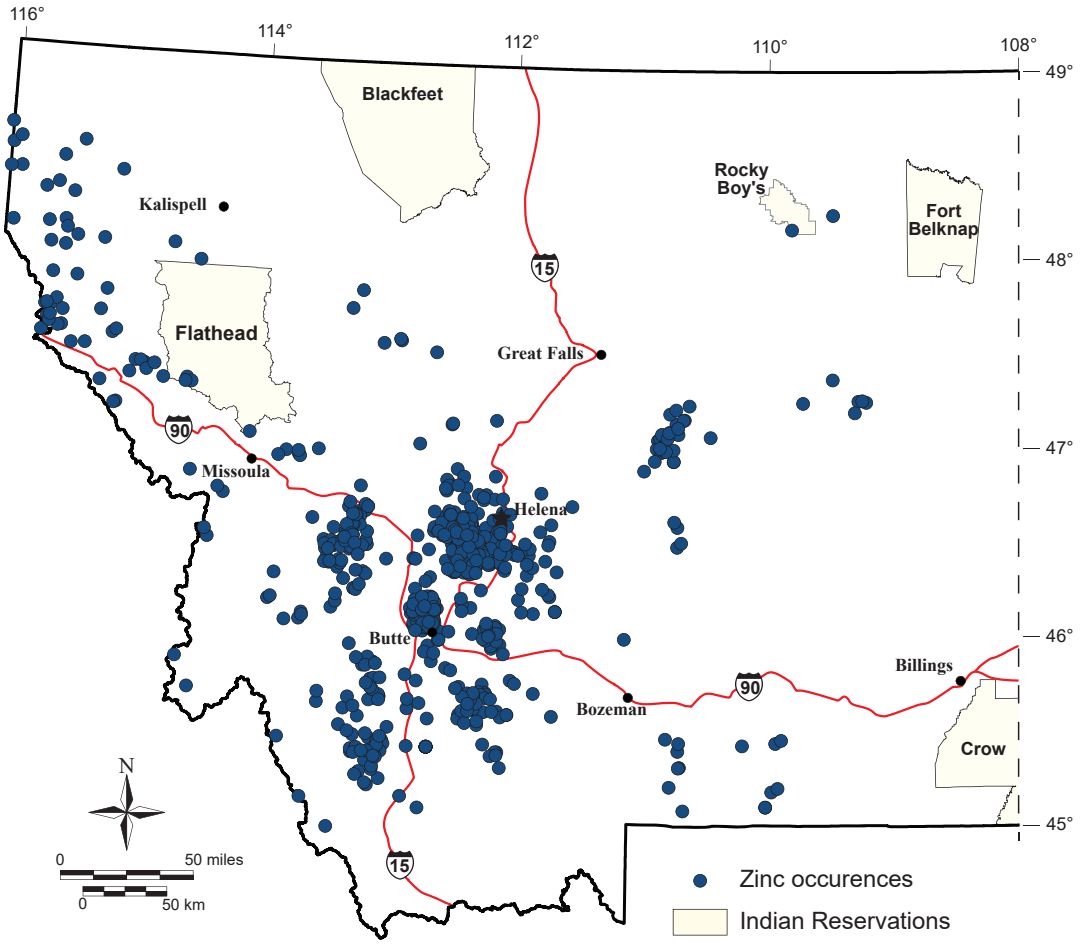

Figure 4. A map of western Montana displaying known occurrences of Zn mineralization.

Deposits in Montana

Montana has produced over 2,500 kt of Zn since 1900. That is almost 3x the current annual consumption level for the United States. Occurrences of Zn mineralization in Montana are restricted to the western half of the State. Historic Zn mining was prevalent around Butte (Silver Bow Co.) and Philipsburg (Granite Co.). The currently operating Continental mine in Butte is a porphyry-type deposit and not particularly Zn-rich.

Other places with the potential for economic Zn mineralization are sediment-hosted deposits in Lincoln, Sanders, and Meagher Counties. A variety of magmatism-associated deposits also occur in Beaverhead, Broadwater, Lewis and Clark, Jefferson, Madison, and Cascade Counties.

Outlook in Montana

Unflooded historic workings around Butte are currently being reevaluated for Zn and other metals. Zn commonly occurs with copper (Cu), lead (Pb), gold (Au), and silver (Ag) throughout Montana. While primarily Cu development, the Black Butte project in Meagher County has many sphalerite occurrences peripheral to the main Cu deposits.

About the MBMG

Established in 1919, the Montana Bureau of Mines and Geology (MBMG) continues to fulfill its mandate to collect and publish information on Montana's geology to promote orderly and responsible development of the energy, groundwater, and mineral resources of the State. A non-regulatory state agency, the MBMG provides extensive advisory, technical, and informational services on the State's geologic, mineral, energy, and water resources. The MBMG is increasingly involved in studies of the environmental impacts to land and water caused either by past practices in hard-rock mining or by current activities in agriculture and industry. The Montana Bureau of Mines and Geology is the principal source of Earth science information for the citizens of Montana. More information is available at mbmg.mtech.edu.