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MBMG
Montana Bureau of Mines and Geology

Critical Mineral: Beryllium

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Overview

Beryllium (Be) is a chemical element included on the United States Geological Survey's 2022 Final List of Critical Minerals. The grayish and brittle, but ultra-light, metal is used in aerospace materials, X-ray tubes, and nuclear energy applications. It is often alloyed with denser metals such as aluminum (Al) or magnesium (Mg) to provide increased hardness and/or corrosion resistance. Be dust can be a major respiratory hazard.

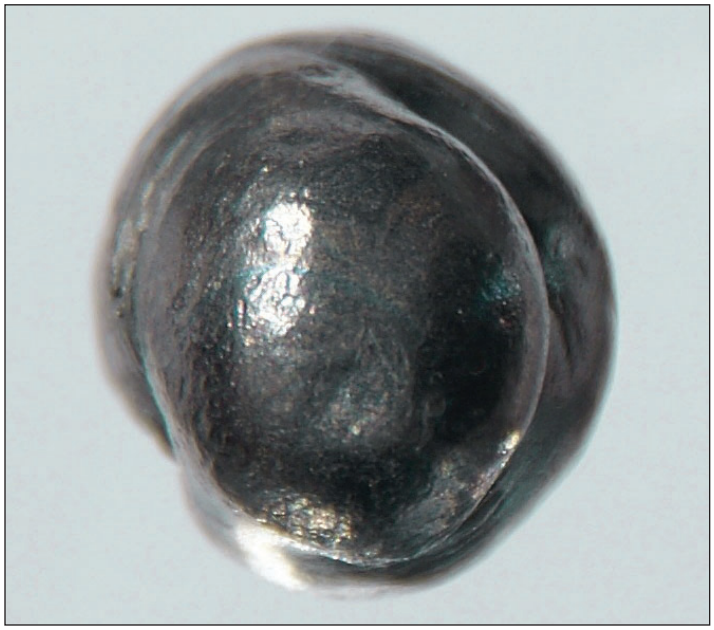

Figure 1. A small, cooled droplet of Be metal. Photo by Hi-Res Images of Chemical Elements (CC-BY-SA-3.0).

Supply

At least 60,000 metric tonnes (t) of known Be resources are in the U.S. across Utah, Nevada, Texas, Alaska, and South Dakota. Another 40,000 t minimum of resources are estimated outside of the U.S. in Mozambique, Brazil, China, and others.

Most of the world's Be production (~85%) is from the Spor Mountain Deposit in Utah. A total of 190 t was produced from this mine in 2023. An unknown amount of Be is also recovered from waste Be alloys. Domestic (and the majority of the world's) Be refining is done at one facility in Ohio. Be pricing has jumped from $660/kg in 2022 to $1,400/kg in 2023. The Spor Mountain resource averages a grade of ~0.26 wt.% Be.

Be is considered a strategic mineral. The U.S. Department of Defense has funded Be mining and refining for many years. Through purchase contracts, the Department maintains a national stockpile of Be. In April 2024, this stockpile contained 2.61 t.

Figure 2. A portable battery-powered X-ray generator used in non-destructive testing for security applications. A "window" of a thin sheet of Be metal allows for the vacuum needed for X-ray generation without impairing X-ray travel. Photo by RadXMan (CC-BY-3.0).

Mineralogy

Be most commonly occurs as silicate minerals. The ore mineral at Spor Mountain is bertrandite. Beryl is the most common Be mineral worldwide, and comprises the ore mineral for Be at most other deposits. Gem variety beryl includes emerald, morganite, aquamarine, and heliodor. Other possible Be ore minerals include chrysoberyl, phenakite, and helvite.

Figure 3. A sample of beryl (variety aquamarine) in quartz from the Calvert Mine, Beaverhead County, Montana. Photo by Jarred Zimmerman (MBMG).

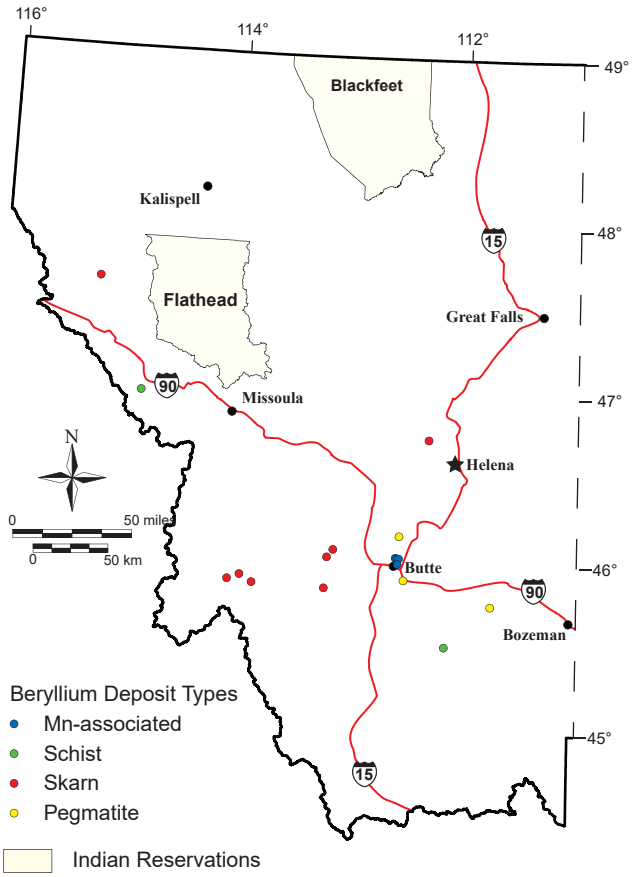

Figure 4. A map of Montana displaying known Be occurrences.

The Spor Mountain Deposit is in a rare variant of Be-enriched and altered volcanic rock as an epithermal deposit. Uranium (U) was also mined at Spor Mountain. Most other Be deposits are hosted in very coarse-grained igneous rocks called pegmatites, or metamorphic rock types called skarn or schist. Other critical minerals that can occur in these rare rock types are fluorspar (CaF_2), lithium (Li), niobium (Nb), tantalum (Ta), cesium (Cs), rubidium (Rb), rare earth elements (REEs), and tungsten (W). In rare cases, anomalously high Be concentrations may be found in hydrothermal polymetallic veins rich in manganese (Mn) and other base metals such as zinc (Zn).

Deposits in Montana

Be mineralization in the State is restricted to the western half. Skarns are the most common host for notable Be in Montana (Beaverhead, Lewis and Clark, Deer Lodge, Sanders, and Ravalli Counties). Mica-rich schists are another host for Be (Madison and Mineral Counties). Both of these rock types are metamorphic. Pegmatite is a coarse-grained igneous rock that can also host Be (Madison and Silver Bow Counties). Beryl is the most common host mineral for these three deposit types. Some reported beryl finds are of gem-quality crystals.

There is a subset of deposits in the Butte Mining District (Silver Bow County) associated with Mn and other base metal mineralization where helvite is a fairly common accessory Be mineral.

Figure 5. Beryl (variety emerald) crystals in a schist from Mineral County, Montana. Rock is about 6 inches long. Photo by Adrian Van Rythoven (MBMG). Specimen donated to the Montana Tech Mineral Museum by John C. Stentz.

Outlook in Montana

Active Be exploration is absent in Montana. Academic and MBMG research is focused on Be potential in deposits such as hydrothermal, skarn, schist, and pegmatite, particularly the waste from past mining of such deposits. This research could support further exploration and development.

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.