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MBMG
Montana Bureau of Mines and Geology

Critical Mineral: Platinum

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Overview

Platinum (Pt) is a chemical element that is included on the United States Geological Survey's 2022 Final List of Critical Minerals. Pure Pt is an unreactive, dense, malleable, and silver-white precious (noble) metal. Pt is best known for its use in jewelry, but has societal importance for its uses in catalytic converters, electronics, glassmaking, and medicine.

Platinum is part of the platinum group elements (PGEs). The PGEs are Pt, palladium (Pd), rhodium (Rh), osmium (Os), ruthenium (Ru), and iridium (Ir). Pt and Pd are by far the most abundant of the six. These elements are found together in most natural deposits. They also have similar physical characteristics.

Figure 1. An ~1 lb nugget of native Pt from Russia. Photo by Chip Clark, Smithsonian Institution (CC BY 2.0).

Supply

PGEs are typically reported as combined grades and masses of all six contained metals. South Africa has the largest PGE reserves at 63,000 t (metric tonnes). Russia (5,500 t), Zimbabwe (1,200 t), and the U.S. (820 t) round out the runners-up. In terms of production, South Africa also leads with 120 t Pt in 2023. Other significant producers in 2023 were Russia (23 t), Zimbabwe (19 t), Canada (5.5 t), and the U.S. (2.9 t). Recycling is an important secondary supply, with 9 t recovered domestically, mostly from older catalytic converters. Other entities that refine and export Pt are the European Union and Switzerland. Compare the domestic mining (2.9 t) and recycling (9 t) production values with overall consumption, 70 t., in the same year. Most domestic Pt mining and recycling occurs in Montana, with some byproduct Pt from the Eagle Mine in Michigan.

Figure 2. A truckload of stolen Pt-containing catalytic converters seized by law enforcement. These components have a ceramic honeycomb interior sprinkled with PGEs that engine exhaust passes through. The gases are made less toxic by way of chemical reactions catalyzed by the PGEs. Due to the high value of PGEs, such thefts are common. Photo by Department of Homeland Security (CC-PD-Mark).

The average Pt value in 2023 was $32,150,700/t. Grades of Pt in deposits range from the byproduct level of ~0.4 g/t (grams Pt per tonne of ore) at the Eagle Mine to ~4 g/t in the Stillwater Complex of Montana.

Mineralogy

Pt can be found as natural alloys of PGEs in a native "nugget" state. It can also occur as sulfide, arsenide, or telluride minerals such as sperrylite, braggite, cooperite,

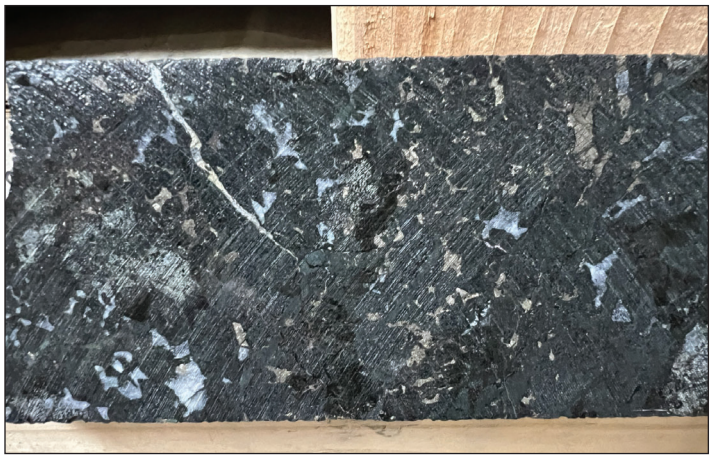

Figure 3. Photograph of a cut core sample from the Chrome Mountain Deposit, Stillwater West project, Sweet Grass County, Montana. Black crystals are olivine, pyroxene, and chromite. The brassy metallic minerals contain PGEs. Photo is ~3.6" across. Photo courtesy of Danie Grobler, Stillwater Critical Minerals Corp.

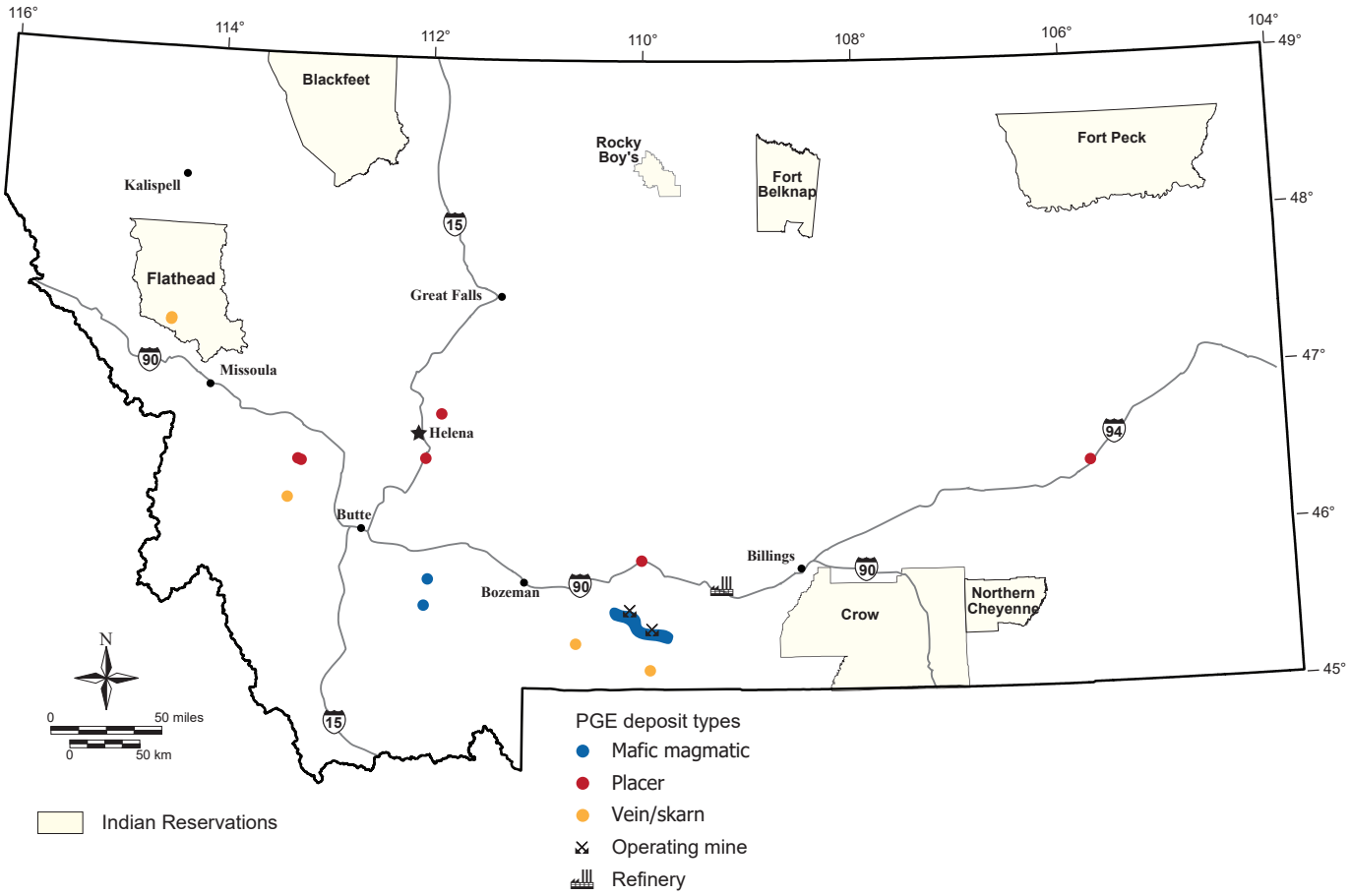

Figure 4. Map of Montana displaying locations of prospective and known Pt mineralization.

platarsite, or michenerite. Aside from arsenic (As), tellurium (Te), and other PGEs, critical minerals that can be found with Pt are antimony (Sb), bismuth (Bi), chromium (Cr), cobalt (Co), nickel (Ni), titanium (Ti), and vanadium (V). Other noncritical commodities commonly found with Pt are copper (Cu), gold (Au), silver (Ag), and iron (Fe).

The main primary deposit type for Pt is ultramafic–mafic intrusion. Byproduct Pt can also occur in other hydrothermal-magmatic deposits: skarn, massive sulfide, porphyry-type, and polymetallic sulfide vein. Weathering of these deposits can concentrate native Pt in placer deposits.

Deposits in Montana

The largest concentration of Pt mineralization in Montana is in the Stillwater Complex, a layered mafic intrusion (Stillwater, Sweet Grass, and Park Counties). The Complex has geologic similarities to the Bushveld Complex in South Africa that hosts the bulk of the Pt in that country. There is also reported magmatic Pt in Madison County. Elevated Pt has been reported in some magmatic-hydrothermal vein and skarn deposits in Sanders (Flathead Reservation), Deer Lodge, and Park Counties. Placer Pt has been reported over a much wider area: Granite, Jefferson, Lewis & Clark, Sweet Grass, and even Custer Counties.

Outlook in Montana

Pt ore is produced from two mines within the Stillwater Complex: the Stillwater Mine in Stillwater County and the East Boulder Mine in Sweet Grass County. These have total resource estimates from 2021 of about 342 t and 280 t of Pt, respectively. The only other formal Pt resource reported in Montana is an inferred estimate of 24 t in 2021 at the Stillwater West project that is adjacent to these two mines. Mineral exploration at the project is ongoing as of 2024.

There is also a major PGE refinery in Columbus, Montana, where ore from the two mines is processed. Also recycled here are PGE-bearing catalytic converters from older automobiles.

Research by the MBMG into waste from mines for other metals in Montana is considering whether Pt could be a critical mineral recovered from these environmental liabilities.

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.