The Philipsburg mining district was one of Montana’s most productive polymetallic-vein districts (24M oz Ag, 36M kg Zn, 1.8M kg Cu, 1M kg Pb, and 450M kg of battery-grade MnO₂), ranking second to Butte, to which it shares many characteristics. Early workers (Emmons and Calkins, 1913; Prinz 1967) described the geology of the district in detail. However, the source, timing, and composition of the mineralizing fluids have never been studied with modern methods.

**Geology and Structure**

Compilation of detailed, historic mine maps is allowing a re-evaluation of the deposit’s structural history in the context of modern plate tectonics. Mineralization occurs as quartz + rhodochrosite ± barite veins and replacements, hosted by Precambrian to Mesozoic metasedimentary rocks and the 75 Ma Philipsburg batholith. The dominant structural feature is an asymmetrical, N-plunging anticline. Dozens of nearly vertical quartz-fissure veins strike predominantly parallel veins and replacements follow the trace of the anticline. This structural pattern is similar to vein orientations in the Boulder Batholith and associated volcanic rocks, and is consistent with E-W shortening in the late Cretaceous. A 65Ma Mo-bearing porphyry stock has been drilled at the north end of the district. The relationship of vein mineraliza-

**Zoned mineralogy**

The north of the district (Hope Hill) contains a higher amount of copper-rich sulfides and barite, but little sphalerite. The center of the district contains Fe-poor, Zn-rich tennantite, enargite, Fe-poor sphalerite, barite, small amount of chalcocite, and silver minerals such as pyrrhotite, jaspilite, and acanthite. The south of the district (Grande-Bimétallic-Rocks) contains a lower sulfidation assemblage of Ag-rich tennantite, Fe-rich sphalerite, arsenopyrite, chalcopyrite, and rhodochrosite. Silver minerals include pyrargyrite and mierargyrite.

**Examples of mineralogy in the center of the district:**

- **Fe-poor sphalerite** shows remarkable color zonation under long-wave UV light. LAICP-MS work is in progress to explain the color variations.
- **Tennantite (Zn-Pb-Mn)** mined for Mn (Mn65 Ma Stewart Gulch porphyry with 65 Ma Granite host rock)
- **Copper-rich Main Stage Veins in center grade to Zn-Pb-Mn in outer zones.** All zones are Ag-rich.
  - Ranges in 3.6‰
  - 2.0 to 3.6‰

**Butte vs Philipsburg**

- **75 Ma Butte Granite**
  - 65 Ma Quartz porphyry dykes with porphyry Cu-Mo ± W
  - Zoned, east-west (modest) trending
  - Cu-Mo ± W lodes
  - Mined for Mn (rhodochrosite)

- **75 Ma Philipsburg Granodiorite**
  - 65 Ma Stwet Granite porphyry with porphyry Mo-Cu ± W
  - Zoned, east-west (modest) trending Ag-Pb-Zn-Cu lodes
  - Mined for Mn (Mo-c cavas)
  - Grande and metasedimentary host rock
  - Zn-rich veins with higher Cu in center of district (enargite-tennantite)
  - All zones are Ag-rich
  - Range in 3.6‰
  - 3.6 to 6.8‰

**Acknowledgements**

- American Federation of Mineralogical Societies
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- Montana Geological Society
- Tobacco Root Geolocial Society
- Montana Tech
- Ted Antonioli—Geologist
- Dave Harris—Miner
- Gary Wyss—Researcher CAMP
- Simon Poulsen—S isotopes, Reno, NV
- Dr. Frank Dudas—Personal communication

**References**

- Prinz, W., (1967) Geology and ore deposits of the Philipsburg District, Granite County, Montana: A study of the silver-arsenic and manganese deposits of the district’s porphyry-batholithic member.

**Study of an impressive yet under-studied mineralization in Philipsburg's polymetallic lode deposits, Granite County, Montana**

Beaucamp-Stout, Celine M., Gammons, Christopher H.  
Dept. of Geological Engineering, Montana Technological University, Butte

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