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Gold-Antimony-Tungsten Deposits of the Stibnite District, Idaho, USA, and Comparison to Chinese Antimony Deposits

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The Stibnite Mining District in central Idaho hosts the USA's largest antimony resource, as part of a multi-million ounce (~140 mt) gold and tungsten deposit. Recent work by the Idaho Geological Survey, the USGS, and property owner, Midas Gold, has documented timing and character of the Au-Sb-W mineralization. Ore is structurally controlled and hosted in a series of Cretaceous Idaho Batholith granitoids (94–83 Ma) and Neoproterozoic to Paleozoic sedimentary roof pendant rocks affected by metamorphism and deformation related to the Mesozoic orogenesis of western North America. Sedimentary strata range from impure dolomitic marbles to quartzites and argillites. Ore is structurally controlled along NS and NE faults of the Meadow Creek and West End Fault Systems. Gold is present in arsenian pyrite and arsenopyrite associated with sulfidized iron-bearing minerals and quartz-carbonate veins with potassium feldspar envelopes and pervasive potassium feldspar in igneous rocks. Minor sericite is present, especially as an early alteration of igneous biotite. Metamorphic minerals in gold-mineralized areas are typically retrograded. Stibnite-carbonate-quartz veins and breccias cut pyritic zones, particularly along faults and cross-cutting dilation zones. Tungsten, as scheelite, is also late and locally coexists with the stibnite. Three samples of hydrothermal K-feldspar associated with gold-bearing zones in the West End deposit have been dated at 50 to 52 Ma by $^{40}Ar/^{39}Ar$ methods (Gillerman et al., 2014). U-Pb geochronology by LA-ICPMS on scheelites returned ages circa 45 Ma and younger (Wintzer et al., 2016). Stibnite-bearing breccias are cut by Eocene-age dikes related to an adjacent volcanic field. Common lead isotope ratios of the sulfides suggest mixing of lead from Cretaceous host rocks and more juvenile Tertiary magmatic sources during the gold stage, but results also indicate a slightly distinct source of lead during antimony mineralization.

Mineralization in the Stibnite District combines characteristics of epithermal and orogenic gold deposits, but it also shares features of sediment-hosted gold systems. No visible gold is present, but electron microprobe analyses show ore stage As-bearing pyrites with zones of 200 to 1,000 ppm gold. Pyrites show complex zoning patterns suggestive of a long-lived hydrothermal system with repeated episodes of high fluid pressures, fracturing, and subsequent mineral deposition. Early Eocene gold-antimony mineralization at Stibnite was associated with tectonic extension, active faulting, and uplift that accompanied continental volcanism tens of millions of years after batholith emplacement along the convergent accretionary margin of western North America. Features shared with antimony-bearing deposits (Zn-Sb-Sn) in China's Guangxi region include polymetallic mineralization, an extensional setting with scattered porphyry intrusions, and weakly metamorphosed Paleozoic carbonate-shale host rocks, possibly carbonaceous. Gold-antimony districts in Kazakhstan and Australia also show structurally controlled mineralization, hydrothermal carbonate, and an association with black shales and clastic rocks. Carlin-type deposits in Nevada and elsewhere share similar stratigraphic and metal associations (Au-As-Sb-

Hg) but may require somewhat different fluid chemistry. Geologic comparisons suggest that large-scale fluid interaction with carbonate host rocks and resulting high CO_2 fluid pressures may be necessary to transport or deposit large volumes of antimony as occurred at Stibnite and deposits such as Xikuangshan.