

Ore and Alteration Characterization of the Zonia Oxidized Copper Deposit, Arizona, USA: A Geochemical, Petrographic, and Geochronologic Approach

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The Zonia ore deposit is an oxidized copper deposit located in the Bradshaw Mountains, Arizona, with an indicated mineral resource of 194 million short tons of 0.25% Cu and an inferred mineral resource of 86 million short tons of 0.2% Cu. The origin of hypogene mineralization has been the subject of conflicting interpretations, with porphyry copper (Proterozoic or Laramide) and volcanogenic massive sulfide deposit types both proposed. The principal aim of this ongoing study is to improve the characterization of the alteration-mineralization of the deposit to address this question of genesis.

Zonia is hosted in the metavolcanic rocks of the Prescott Volcanic Belt, which include greenstones and chlorite-, sericite- and talc-dominated schists, a light-colored quartz-feldspar porphyry (new U-Pb zircon: 1692.6 ± 11.9 Ma and 1715 ± 18 Ma), and quartz-sericite schists. Along the NW margin of the deposit is a biotite granodiorite to monzogranite (new U-Pb zircon: 1743 ± 18 Ma).

Hypogene mineralization at Zonia is typified by variably deformed quartz-pyrite±chalcopyrite±molybdenite veins. The supergene minerals include malachite, chrysocolla, cuprite, and limonite, with replacement rims of chalcocite and covellite on chalcopyrite now also identified. At Zonia, the supergene mineralization is generally enriched in Au, As and Cu, while hypogene mineralization is enriched in Cu and Mo. Reconnaissance whole-rock geochemical analyses reveal Te and Bi enrichment up to three orders-of-magnitude above crustal abundance in hypogene ores. In supergene ores, Se is enriched two to three orders-of-magnitude greater than average crustal abundances. Elevated Co, Cr, Sn, and Zn were also encountered across different mineralization types.

Ongoing work includes detailed petrography and characterization of veins and defining vein types. Mineral chemistry of alteration and ore minerals will refine our understanding of the distribution and deportment of critical minerals within Zonia. Finally, we will relate the alteration-mineralization to mineral deposit models to consider deposit genesis.