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Age and Genesis of W–Mo–Cu Mineralization, Gold Hill, Utah

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Utah's Gold Hill mining district hosts a Jurassic felsic pluton emplaced into a Mississippian–Pennsylvanian carbonate-dominated sedimentary sequence that is spatially associated with numerous polymetallic (potentially skarn-type) mineral deposits. The timing of mineralization in this district has not previously been constrained, resulting in uncertainty on the relationship between mineralization and pluton emplacement. This study presents new geochronological data for understudied W–Mo–Cu mineralization associated with a Jurassic pluton and outlines key relationships between the geological setting, magma composition, and paleo-fluid evolution of these polymetallic systems.

Six molybdenite samples dated using the Re–Os technique yielded five ages between 156.8 ± 2.2 and 154.4 ± 2.2 Ma that are consistent with existing unpublished zircon U–Pb ages for the proximal pluton (156.1 ± 1.8 Ma). This suggests that the pluton was likely the controlling factor in the generation of the molybdenite and associated mineralization in this area, indicating these are most likely skarn systems. However, an older age of 165.6 ± 2.4 Ma for the sixth low-Re sample provides evidence of multiple pulses of molybdenite mineralization, potentially indicating an earlier non-skarn molybdenite phase of mineralization or that some skarns are associated with a hitherto unidentified earlier phase of intrusion. This study also presents in-depth petrographic analyses from several mines in the district which outline key paragenetic relationships (cross-cutting and overprinting) and mineral assemblages that constrain the timing of alteration and mineralization. These include (1) early actinolite, apatite, diopside, and scheelite(?) skarn alteration, (2) a main molybdenite, chalcopyrite, bornite, pyrite, magnetite, hematite, and calcite phase of mineralization, and (3) post-skarn supergene malachite, azurite, chrysocolla, chalcocite, calcite, and limonite alteration. Future SEM imaging and EPMA will provide further insights into the genesis of W–Mo–Cu mineralization in the Gold Hill district as well as future exploration targeting in similar terranes.