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Updated Observations on Orogenic Gold Mineralization in Grass Valley, California: New Pb- and Au-Phase Relationships and In Situ Pb Isotopes

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Gold-quartz veins in Grass Valley, California were mined between 1850 to 1957, producing an estimated 10.4 million ounces. Located in the northern Sierra Nevada foothills, the veins are hosted in the Lake Combie Complex, a ~200 Ma accreted island arc, cut by the ~160 Ma Grass Valley granodiorite.

Gold mineralization timing in Grass Valley and similar Mother Lode districts has been reported by several authors using various methods such as hydrothermal mica K-Ar, whole rock Rb-Sr, pyrite Re-Os, mariposite Ar-Ar, and REE-phosphate U-Pb. These studies lack evidence of a cogenetic textural relationship between the analyzed mineral and gold. In our study, we document textures of Pb-rich minerals and gold from Grass Valley veins and will utilize in situ laser ablation ICP-MS on Pb-rich minerals found with and without a cogenetic textural relationship with gold.

Quartz vein and mineralized host rock samples gathered from historic mines and collections were prepared in epoxy mounts for reflected light and scanning electron microscopy. Gold phases, native gold and petzite, are found in multiple unique cogenetic textures with Pb-rich phases, galena and altaite. Native gold and galena are found together as inclusions in quartz, in pyrite, filling fractures in pyrite, and along mineral boundaries, at times with altaite as well. Native gold is also observed as globular inclusions in galena. Petzite is found with altaite in telluride clusters, and with altaite mantling hessite.

We anticipate mostly unique isotope populations, with some similarities, across each different textural setting of galena and altaite. The combination of extensive microscopy and in situ geochemistry from Pb-phases will yield a detailed isotopic dataset, compared against published and newly collected regional Pb-isotope data, for determination of ore fluid source and timing information from unique mineralizing episodes. This approach can be expanded to other hydrothermal ore deposits, providing more refined insights.