GEOCHRONOLOGY AND GEOCHEMISTRY OF MID-MIOCENE BONANZA LOW-SULFIDATION EPITHERMAL ORES OF THE NORTHERN GREAT BASIN, USA

Derick Lee Unger

Ore petrography, geochemistry, and geochronology data collected for some low-sulfidation epithermal precious metal deposits in the northern Great Basin indicate that the mid-Miocene deposits have consistent ore mineralogy, geochemistry that varies between two end members, and a narrow range of ages. These deposits are coeval with bimodal volcanism and often classified as “volcanic-hosted.” However, a number of deposits in this study are not hosted by volcanic rocks and it appears that the host rock may significantly affect gangue mineralogy. New high precision 40Ar/39Ar geochronology conducted on previously undated deposits (or deposits with older, less precise K/Ar dates only), indicates that low-sulfidation epithermal Au-Ag mineralization in the northern Great Basin began around 16.5 Ma and continued until at least 15.6 Ma. This time frame adds further support to the hypothesis that these deposits are genetically related to the emergence of the Yellowstone hotspot near the present day intersection of the Idaho, Nevada and Oregon borders. High-grade bonanza ores in these deposits consist of precious metal minerals inter-grown with quartz and adularia ($KAlSi_3O_8$). The intimate association of precious metals with adularia, an ideal mineral for use in 40Ar/39Ar geochronology, allows for unambiguous dating of the precious metal mineralization event. For this study, five adularia crystals from each sample location were analyzed individually rather than as a bulk sample. The effects of argon loss or gain are much more evident in single crystal analysis and thus can be mitigated during the final age calculation.

Deposits in or near the Slumbering Hills (Jumbo, New Alma, Sandman and Ten Mile) northwest of Winnemucca, Nevada as well as two locations on War Eagle Mountain, Silver City District, Idaho, were selected for geochronologic study. A new younger age of 16.53 ± 0.04 Ma at the 1σ confidence level was determined for the Jumbo deposit. Evidence for excess Ar was found in the samples from Jumbo, which likely explains an anomalously old date of 17.3 Ma that was previously determined using K/Ar methods. The youngest deposit in the Slumbering Hills area is the New Alma deposit (16.03 ± 0.07 Ma), which sits just south of the Jumbo deposit. The Ten Mile and Sandman deposits fall in between with ages of 16.52 ± 0.04 Ma and 16.17 ± 0.04 Ma respectively. The presence of the recently mined Sleeper deposit and the Sandman deposit, which is a current exploration target, indicates the Slumbering Hills area may host other significant bonanza ores. War Eagle Mountain vein samples yielded ages of 16.31 ± 0.04 Ma and 15.61 ± 0.10 Ma. The geochronology data as a whole indicate that precious metal mineralization occurred in the region for a period of at least 1 Ma.

Suites of ore samples from several low-sulfidation deposits in the northern Great Basin were collected to examine similarities and contrasts in the mineralogy and geochemistry. Polished thin section petrography and geochemical data indicate that the most common precious metal minerals are electrum and Ag-selenides, Ag-sulfides, and Ag-sulfosalts. A new classification scheme, the “epithermal trilinear diagram,” based on metal and metalloid contents in these ores, was devised to examine geochemical properties within and amongst deposits. Each geochemical sample plots as a point on a trilinear diagram based on certain metal (Au, Ag, Pb) and metalloid (As, Sb, Te, Se) molar ratios. For the sake of comparison, some low-sulfidation ores from Colorado and Japan were included in this portion of the study. This new classification scheme indicates deposits fall between two end members being either Ag-Se or Au-Te rich. The Colorado ores analyzed all fall in or near the Au-Te field, whereas samples from the northern Great Basin and Japan generally plot in or near the Ag-Se field. The greatest determining factor in where a sample falls in this technique is the metalloid content.