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Mineral Chemistry, Fluid Inclusion, and Isotopic Characteristics of the Enargite Orebodies at Lepanto, Mankayan, Philippines

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Enargite and luzonite are major ore minerals in high-sulfidation epithermal Cu-Au deposits. These minerals have also recently gained interest due to their enrichment in some critical metals, such as Sb, Te, and Ge. In this study, we report new results on mineral chemistry, fluid inclusion microthermometry, sulfur and lead isotope signatures of enargite from the Lepanto high-sulfidation epithermal Cu-Au deposit in the Philippines, and their implications for deciphering the ore-forming processes in the deposit.

Elemental mapping shows that enargite hosts native tellurium, goldfieldite and Au-Ag tellurides inclusions. Enargite and luzonite contain up to 5 wt % Sb and up to 5,000 ppm Te. Variations in Sb and Te contents generally follow the crystal growth planes. Near-infrared microscopic observations revealed that enargite hosts two-phase liquid-vapor fluid inclusions that homogenize to liquid between 205 to 240°C. Fluid salinity ranges from 2.5 to 5.7 wt % NaCl equiv. Bulk gas analysis indicates that the fluid inclusions dominantly contain H_2O with 0.1 to 3 mol % CO_2 and 0.0006 to 0.02 mol % H_2S. N_2/Ar ratio widely varies between 2 and 120. Sulfur isotopic ratios ($\delta^{34}S_{CDT}$) of enargite range from -6.0 to -3.0 ‰, typical of sulfide minerals that were formed from H_2S produced from magmatic SO_2 disproportionation at magmatic-hydrothermal temperatures. Lead isotope ratios of enargite range from 38.48 to 38.53 for $^{208}Pb/^{204}Pb$, 15.57 to 15.59 for $^{207}Pb/^{204}Pb$, and 18.41 to 18.43 for $^{206}Pb/^{204}Pb$, which are similar to the Pb isotopic composition of the Pleistocene dacite in northern Luzon.