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Characteristics of high grade Au-Ag mineralization at the Hishikari deposits, Kagoshima, Japan

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The Hishikari gold-silver deposits in Kagoshima, Japan, are world-class low-sulfidation vein-type epithermal deposits, which are subdivided into the Main, Sanjin, and Yamada deposits [1]. The deposits are hosted by rocks of the Cretaceous Shimanto Supergroup and Pleistocene Hishikari Lower Andesite. Potassium-Ar and $^{40}Ar/^{39}Ar$ dating in previous studies yielded a range of ore-forming ages of 1.33-0.61 Ma [e.g. 1, 2, 3]. We investigated Au-Ag mineralized quartz veins collected from the Keisen 3-1 vein at the 17.5 ML, 25 ML, and 40 ML (relative to sea level) in the Sanjin deposit on the basis of microscopy, X-ray powder diffraction, bulk and mineral chemical composition analyses, fluid inclusion microthermometry and gas composition analysis, and isotope analysis, in order to reveal characteristics of high-grade gold mineralization.

The Au-Ag-mineralized quartz veins include gangue minerals of mainly quartz, calcite, adularia, saponite, and truscottite, and ore minerals of electrum, hessite, sphalerite, and galena-clausthalite solid solution. In the quartz veins from the 17.5 ML, a large amount of electrum occurs with saponite and adularia in early mineralization sequences, *i.e.*, a sequence near the wall rock or a sequence surrounding the brecciated quartz vein. Average sizes of electrum grains in several mineralized sequences are between 3 and 13 micro-meters, and the abundance of electrum and their grain size are positively correlated. The Au/(Au+Ag) of electrum ranges mainly from 57 to 70 atomic %. The Au/(Au+Ag) of electrum in the early sequences is relatively high. In these samples, homogenization temperature and salinity of quartz-hosted fluid inclusions range from 200 to 220 ^{o}C and from 1.1 to 2.2 wt% NaCl eq., respectively. Calculated oxygen and hydrogen isotope values for fluids that deposited the saponite in the quartz veins from the 17.5 ML and 25 ML are relatively heavier than those of current meteoric and geothermal waters. The results are interpreted to suggest: 1) mixing of high-temperature volcanic gas with meteoric water, and/or 2) an evaporation effect in a disequilibrium state. Fugacity of tellurium ($\log f_{Te_2}$) based on the electrum tarnish method was estimated to range from -15 to -14 atm. The fugacity of tellurium in the early sequences of high Au-grade mineralization was higher than that in the late sequences. Fluid inclusion gas analysis using the CFS (crush-fast scan) method [4] yielded a meteoric fluid signature for the samples from the 40 ML, in which the presence of fluid inclusions with salinities as high as 5.1 wt% NaCl eq. were reported [5]. The analysis indicates the fluid inclusions in high Au-grade quartz have relatively large amounts of volatiles and vice versa.

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