Mineralogical and Geochemical Studies of Mesothermal Gold Mineralization at Seolhwa Mine, Korea

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Mesothermal gold mineralization of the Seolhwa mine was deposited in a single stage of massive quartz veins which filled the mainly NE-trending fault shear zones exclusively in the granitoid within the Gyeonggi Massif. The mesothermal-type deposits documented up to date in South Korea are exclusively gold-rich and are characterized by being situated solely within Precambrian paragneiss, and by a single stage of massive quartz veins, the simple mineralogy consisting of poor sulfides and gold with an absence of any silver-sulfosalts, and the weak wall-rock alteration.

The Seolhwa mesothermal gold mineralization are associated with the S-type, ilmenite-series "Seolhwa granitoid" (161Ma). The vein quartz contains three main types of fluid inclusions at 25℃: low-salinity (<5 wt. % NaCl), liquid CO_2-bearing, type IV inclusion; gas-rich (>70 vol. %), vapor-homogenizing, aqueous type II inclusions; and aqueous type I inclusions (0~15 wt. % NaCl) containing small amounts of CO_2. The H_2O-CO_2-CH_4-N_2-NaCl inclusions represent immiscible fluids trapped earlier along the solvus curve at temperatures of 430° to 250℃ and pressures of 1 kbars. Detailed fluid inclusion chronologies may suggest a progressive decrease in pressure during the auriferous mineralization. The aqueous inclusion fluids represent either later fluids evolved through extensive fluid unmixing (CO_2-CH_4 effervescence) from a homogeneous H_2O-CO_2-CH_4-N_2-NaCl fluid due to decreases in temperature and pressure, or the influence of deep circulated meteoric waters possibly related to uplift and unloading of the mineralizing suites. The initial fluids were homogeneous H_2O-CO_2-CH_4-N_2-NaCl fluids as follows: >250° to 430℃, X_{CO2} of 0.16 to 0.62, 5 to 14 mole % CH_4, 0.06 to 0.31 mole% N_2 and salinities of 0.4 to 4.9 wt.% NaCl. The T-X data for the Seolhwa gold mine may suggest that the Seolhwa auriferous hydrothermal system has been probably located nearer to the granitic melt which facilitated the CH_4 formation and resulted in a reduced fluid state(indicated by the predominance of pyrrhotite). The fugacity of sulfur of the auriferous mesothermal fluids progressively decreased close to the pyrite-pyrrhotite curve.

Measured and calculated isotopic compositions of the mesothermal fluids [$\delta^{18}O$ = 5.3 to 6.5 ‰; δD = -69 to -84 ‰] provide evidence of CH_4-H_2O equilibria and further may indicate that the auriferous mesothermal fluids were magmatically derived. Both the dominance of negative $\delta^{34}S$ values of sulfides(-0.6 to 1.4 ‰; $\delta^{34}S_{\Sigma S}$ values of 0.3 to 1.1 ‰) and the available $\delta^{13}C$ data (-4‰) are consistent with their deep igneous source, probably the ilmenite-series. The Seolhwa mesothermal gold deposits were probably formed by extensive fracturing and veining due to thermal expansion of waters derived from the Jurassic "Seolhwa granitoid" melt (probably formed by dehydration of mica-rich Precambrian paragneiss). Such a thermal expansion of magmatic waters might have been accompanied by the uplift and unloading of deeply buried metamorphic terrain or the decrease of the least principal stress during the late stage of the Daebo orogeny. The fluid's chemical characteristics and the pressure-depths of the Seolhwa

auriferous mesothermal deposits are similar to those estimated in the Archean gold deposits, possibly indicating not only the general application of the magmatic model to the mesothermal deposits worldwide but also extending to non-Archean mineralization epochs related to postorogenic granitoid intrusion.

Key words: Mesothermal gold, fluid inclusion, stable isotope, magmatic model

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