

Porphyry Cu-Au-Ag Mineralization of the Haman Alkaline-Carbonatite Intrusive Complex, South Korea

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The Haman Cu-Au-Ag project is located in the southeast of the Korean peninsula and was the main copper-producing region of South Korea up until 1945.

Situated within the Cretaceous Gyeongsang basin, host rocks comprise siltstone, mudstone with evaporites (Haman Formation), and “red bed” sandstones (Jindong Formation) deposited into a shallow lacustrine-playa environment under prevailing semi-arid climatic conditions.

Tonalite was emplaced at 118-110 Ma, followed by monzonite and feldspar porphyry intrusions between 105-95 Ma. The tonalite has cooled and crystallized inwards, with successive reactions involving uralitization of pyroxene to amphibole and albitization of plagioclase, generating residual magmatic fluids enriched in Au, Ag, Cu, Co, W, Bi, As, Mo, and Zn into late monzonite and feldspar porphyry phases. Central cores of the tonalite coincide with intense “bullseye” aeromagnetic anomalies and pyrite-magnetite-biotite-albite alteration. The intrusions are geochemically classified as high-silica adakites and lie within the fertile field for alkaline porphyry Cu-Au intrusions.

Gabbro has intruded the northern margin of the tonalite and was accompanied by NNW striking carbonatite and serpentinite dykes, emplaced between 97-85 Ma. Microgranular magmatic enclaves in the tonalite, monzonite, and gabbro suggest granitic and mafic enclaves crystallized contemporaneously as a result of the injection of a hot dense mafic gabbro melt into the adjacent monzonite magma chamber and still crystallizing warm tonalite. Mineral components of the carbonatite dykes include kaersutite, garnets, chamosite, traces of xenotime and apatite, while serpentinite dykes contain olivine and are suggestive of a mantle hot-spot plume.

Cu-Au-Ag mineralized breccias were deposited along dyke margins and consist of bands of quartz, magnetite, specularite, hematite, carbonate, actinolite, chlorite, and sulphides with a fluidized, brecciated igneous texture. Mineralization was dated at 84.0 Ma and probably deposited from late-stage magmatic hydrothermal fluids associated with the dykes. The intrusive rock suite at Haman is interpreted as an alkaline-carbonatite porphyry Cu-Au complex.