CERAMAH TEKNIK TECHNICAL TALK

CONTROLS OF COPPER AND GOLD DISTRIBUTION IN THE KUCING LIAR DEPOSIT, ERTSBERG MINING DISTRICT, PAPUA PROVINCE, INDONESIA

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Abstract: Kucing Liar is a large sediment-hosted Cu-Au mineralized system containing some 15 Moz of gold and 5 Mt of copper in ~500 Mt of ore. It is situated in the Ertsberg Mining District in the Central Ranges of New Guinea, in the Indonesian province of West Papua. This study demonstrates that high sulphidation ore is continuous with typical porphyry-skarn style chalcopyrite ore and that both have formed from mixing of magmatic with meteoric waters within a zone of fault offset.

Alteration and mineralization were localised within calcareous shale and thinly bedded limestone adjacent to the Grasberg Igneous Complex where they are zoned around fault offsets. Early phases of alteration are stratiform and are juxtaposed against the Idenberg Fault Zone, which has displaced host stratigraphy at least 600m vertically and possibly up to ~1,500 m laterally. Four principal hydrothermal mineral associations are (1) calcic and magnesian skarn, (2) potassic assemblages including magnetite, (3) quartz-muscovite plus anhydrite and (4) locally massive pyrite. Cu and Au are associated with pyrite and occur discretely either as chalcopyrite ± bornite with an association of Cu-Au-Co (Zn-Pb) or as covellite ± enargite associated with Cu-Au (As-Sb-Hg). 40Ar/39Ar geochronology shows muscovite (3.18 ± 0.02 Ma) was coeval with potassic-biotite assemblages (3.18 ± 0.02 Ma and 3.20 ± 0.04 Ma). Calcic and magnesian skarn were derived from magmatic fluids (δ^{18}OFLUID = 9-6‰), while potassic and magnetite alteration were derived from high temperature (>650°C), high salinity (>50wt% NaClEQUIV.) magmatic fluids (δ^{18}OFLUID = 6-12‰). Quartz infill crystals associated with voluminous silicification contain a variety of fluid inclusions that range from moderate temperature (TH<420°C) high and moderate salinity brines (35-55 and 15-30wt% NaClEQUIV.), to low density - low salinity vapour-rich fluid inclusions. Fluorite-hosted inclusions with lower TH (<300°C) and salinity (~5wt% NaClEQUIV.) are also related to quartz alteration. Quartz alteration, muscovite and anhydrite have estimated δ^{18}OFLUID ranging from 0-6‰. δD data from magnesian skarn suggest that the magma source was strongly but variably degassed during skarn formation while clustering of biotite and tremolite δD data may indicate ponding of fluids prior to exsolution, which was preceded by monzonite dyke emplacement that were emplaced during skarn and potassic stage alteration.

Fluid infiltration was controlled by an active fault system characterised by strike-slip deformation overprinting a pre-existing reverse-slip fault. Periodic slip allowed infiltration of the magmatic fluids while a complex structural offset controlled the mixing of magmatic and meteoric fluids. Fluid mixing was augmented by phase separation which gave rise to brine and vapour-rich phases that migrated differently due to density contrasts. Ore deposition was related to mixing of magmatic and meteoric fluids, which resulted in an increase in H_2S relative to SO_2, causing intense sulphidation of magnetite and precipitation of sulphides, beginning with gold-rich chalcopyrite-dominant mineralization. High sulphidation covellite-style mineralization occurred by contraction of the vapour phase that had separated from quartz-forming brines. Au, As and Sb were partitioned away from the high sulphidation copper mineralization due to higher solubilities of these metals as bisulphide complexes and deposited in distal pyrite along with chloride-complexed Pb and Zn.