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1 Ertsberg East Skarn System

The Ertsberg East Skarn System (EESS), a 3 Gt orebody at 0.59% Cu and 0.49 ppm Au, is located in the Ertsberg-Grasberg mining district, a 50km² region of world class Cu-Au porphyry and skarn deposits in the highlands of Papua, Indonesia (Leys et al., 2012). The region is tectonically complex; subduction of the Australian plate beneath the Pacific plate ca. 12 Ma (Cloos et al., 2005) uplifted and deformed a succession of Upper Cretaceous siliciclastic to Lower Paleogene carbonate strata that serve as host rocks for the skarn orebodies. The transition to a strike-slip margin ca. 4 Ma is associated with ca. 3 Ma magmatism and episodic hydrothermal fluid flow, which resulted in porphyry stockwork and skarn mineralization (Cloos et al., 2005). Whereas the neighboring Grasberg porphyry Cu-Au deposit is believed to have formed by the throttling cupola mechanism, a process where hydrothermal fluids collect at the top of a batholith and periodically are released into the overlying magmatic complex (Cloos & Sapiie, 2013), the origin and transport mechanism for the fluids that formed the EESS are unknown.#$

Several structural and stratigraphic pathways have been proposed as EESS fluid conduits connecting a deep fluid source with the reactive carbonate strata (Gandler, 2006), but controls on the P-T-X conditions of calc-silicate alteration and Cu-Au mineralization are essential to describing skarn formation. Cu-Au mineralization in the EESS is stratigraphically controlled in the exoskarn and also occurs within hydrothermal quartz veins in the endoskarn, hornfels, and exoskarn facies (Gandler, 2006). This relationship suggests that quartz veining and silicification record the evolution of fluids during calc-silicate alteration and Cu-Au mineralization. ESEM-Cathodoluminescence imaging reveals zonation textures and cross-cutting relationships in vein quartz that results from changes in the P-T-X conditions and growth rates throughout multiple generations of Si-saturated fluid input. When partnered with fluid inclusion analysis and Ti in quartz thermometry, it may be possible to quantify fluctuations in the depositional conditions of Cu-Au skarn formation with time to identify the pathways of mineralizing fluid migration.

2 Methods and Preliminary Results

Preliminary studies have focused on establishing a paragenetic sequence of Ertsberg East Skarn formation and precipitation of quartz-sulfide-anhydrite veins. Growth zoning in calc-silicate skarn minerals is consistent with Fe-Al compositional variation identified with SEM element maps. SEM-Cathodoluminescence imaging of quartz reveals concentric zonation, dissolution surfaces, and low intensity luminescence adjacent to sulfides (Fig 1). Individual SEM-CL images are stitched into composite luminescence maps, and colored filters are used to capture specific wavelengths of light, which are overlain to produce color images. Polyphase fluid inclusion populations are observed in discrete compositional zones within vein quartz, epidote, and garnet. Vein quartz crystals contain both vapor-rich inclusions and inclusions with complex daughter salt assemblages indicative of retrograde boiling (Fig 2).#$

Anhydrite vein-fill and quartz disseminated in wallrock contain two-phase fluid inclusion populations. Color SEM-CL images of quartz mineralization have revealed that luminescence is dominated by blue wavelengths, suggesting that Ti is a prominent trace element and provides context for Ti thermometry. Preliminary SEM investigation has revealed the presence of native gold and

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Electrum in association with Cu-Fe-sulfides and as inclusions in quartz. High resolution X-ray computed tomography (Kyle et al., 2008) will be used to assess the three-dimensional relations of gold and copper sulfides with other alteration features, providing further constrains on the evolution of the EESS.

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References


