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Title: ANTAPACCAY PORPHYRY CU-AU DEPOSIT: A PRODUCT OF ANDEAN TECTONISM AND EVOLVING MAGMATISM, LATE EOCENE-EARLY OLIGOCENE ABANCAY BATHOLITH, ALTIPLANO, SOUTHERN PERU

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Abstract: This study focuses on the petrogenesis of intrusions and associated mineralisation at Antapaccay, part of the Abancay Batholith. Antapaccay is a Cu-Au porphyry deposit of moderate size and grade with zones of high grade skarn, and epithermal mineralisation. Copper was introduced with retrograde exoskarn, sodic-calcic, potassic, phyllic, transitional and argillic alteration assemblages. Hydrothermal activity is associated with multiple intrusive and mineralising events and continued from 38.4 to 34.0 Ma. Magmatic fluids at temperatures between +700 and 300°C were responsible for the skarn, sodic-calcic, potassic, phyllic and transitional alteration. 200 to 80°C argillic alteration resulted from mixing of high temperature magmatic vapour and meteoric fluids.

Intrusives were emplaced at Antapaccay between 39.9 to 32.5 Ma. The Abancay Batholith and Antapaccay intrusive suite have atypical, medium to high-K but also high-Na, calc-alkaline chemistry. Cyclic enrichment in MgO and compatible transition elements, compositionally diverse amphibole phenocrysts, and mineral/melt disequilibrium textures, show four cycles of differentiation and back-mixing with a hydrous basaltic melt. Fractionation was hydrous and dominated by hornblende. The magma differentiated at a wide range of pressures corresponding to a lower crustal hot zone, a mid-crustal magma chamber, and upper-crustal conduits. Oxygen fugacity

increased with decreasing temperature relative to ferrous-ferric iron buffers, reflecting buffering by the $\text{H}_2\text{S}-\text{SO}_2$ reaction. Increases in SO_3 in apatites and water contents from successive intrusive phases demonstrate the role back-mixing with the hydrous basaltic melt played in increasing volatile contents. Anhydrite microphenocrysts and inclusions of sulfide melt indicate that the melt became saturated in sulfur. Hydrothermal fluid exsolution is estimated to have occurred 2-5 km below a 6 km emplacement depth. Inclusions in magmatic and hydrothermal quartz show that immiscible silicate melt, salt melt, and sulfide melt coexisted with the exsolved highly saline, silica-saturated aqueous fluids.

Magmatism and mineralisation at Antapaccay was coincident with the Incaic compressive event, a period of rapid crustal growth of more than 10 km thickness over ~6 m.y, that created a proto-Altiplano in the late Eocene. Periodic mafic recharge after the Incaic compressive event sustained a prolonged period of magmatism and hydrothermal activity at Antapaccay and produced porphyry productive granitoids saturated in sulfur. Magmatic-hydrothermal evolution synchronous with uplift and erosion resulted in superposition of shallow epithermal mineralisation on deep porphyry and skarn mineralisation. The location of the Abancay batholith, 250-390 km from the modern Peru-Chile trench and 120 km behind the active arc, is evidence that the magmatism and crustal thickening were associated with a transition from normal to flat-slab subduction from the late Eocene to early Oligocene.