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Geologic, Geochronological, Mineralogical, and Geochemical Evidence from the Cretaceous Los Negritos Porphyry Copper Mineralized System, Chile

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The Los Negritos porphyry copper mineralized system is located ~4 km to the northeast of the Carmen de Andacollo Mine, the largest porphyry deposit in the Chilean Cretaceous metallogenic belt. This study included field work, mineralogical, geochemical, and geochronological investigations to determine the spatial distribution, signature, and overall evolution of the Los Negritos mineralized system. Mineralization at Los Negritos is hosted by andesite of the Quebrada Marquesa Formation and a series of at least four early to intramineral porphyritic intrusive rock types (named P1, P2, P3, P4), all dated by SHRIMP U-Pb in zircon: plagioclase quartz biotite porphyry (P1a: ca. 110 Ma and P1b: ca. 108 Ma); plagioclase biotite porphyry (P2: ca. 106 Ma); and quartz plagioclase biotite porphyry (P3: ca.106 Ma). These units are cut by late- to postmineral plagioclase-hornblende porphyritic rocks (P4a: ca. 106 Ma and P4b: ca. 106 Ma).

The earliest intrusive units (P1) were affected by an initial stage of K-feldspar-biotite alteration and associated chalcopyrite, molybdenite (Re-Os age ca. 109 Ma), and minor gold. Surrounding volcanic host rocks were overprinted by chlorite-epidote-dominated alteration. Subsequent to P2 and P3 intrusion, an albitic alteration followed by a second stage of potassic alteration affected intrusive units and volcanic wall rocks. These early stages of alteration were overprinted by copper-molybdenum-bearing chlorite-sericite alteration at ca. 107 Ma (Re-Os age in molybdenite) and by quartz-sericite-pyrite veins, respectively, in the southwest and northeast areas. Weak albite-calcite alteration, spatially associated with sulfosalts and distributed along the margins of P3, overprinted the quartz-sericite-pyrite facies.

The intrusive rock units at the Los Negritos and Carmen de Andacollo deposits are geochemically classified as diorite to granodiorite with a calc-alkaline affinity and formed in a volcanic arc setting from partial melting of a metasomatized mantle wedge. They are interpreted to be cogenetic and related to a common long-lived magma chamber that was emplaced during a period of tectonic inversion known as the Subhercynian, Peruvian, or Pacific event. This was synchronous with the formation of world-class IOCG deposits in Chile and Peru and iron oxide-apatite (IOA) deposits, representing a major metallogenic event. The integration of these results with the evolution of the Andean metallogenic belts will assist in understanding the relationship between porphyry and IOCG systems and implications for exploration models.