The Relincho Porphyry Cu-Mo Deposit, Atacama Region, Chile

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Relincho is a Paleocene porphyry Cu-Mo deposit located 45 km east-northeast of Vallenar, Chile, at an elevation of 1,500 to 2,100 m in the foothills of the Andean Cordillera. The deposit has proven and probable reserves of 1,104.5 Mt at 0.41% Cu and 0.021% Mo, plus measured and indicated resources of 646.1 Mt at 0.32 % Cu and 0.013 % Mo (Teck Resources Limited, 2012). Sporadic, small-scale mining of narrow, high-grade Cu-Au-Ag veins has taken place in the district since the early 1900s, but systematic exploration did not commence until 1970, when a Chilean-Romanian consortium optioned the property, and began exploring with shafts, adits, and drilling. This program terminated after two years and the property remained dormant for the next 20 years. In 1993, Outokumpu Chile SA acquired the property and completed district- and prospect-scale geologic mapping, outcrop sampling, geophysical surveys, and 43,028 m of drilling. Outokumpu considered the project uneconomic and exploration ceased in 1997. Placer Dome acquired the property in 2000 and maintained the tenure but did not do any exploration. Lumina Copper purchased the property in 2003 and their subsidiary, Global Copper SA, began an aggressive exploration program designed to delineate oxide resources and expand the sulfide resource. Teck purchased the property from Global Copper S.A. in 2008 and commenced a feasibility study on the project, which is currently in progress.

The Relincho porphyry deposit is emplaced into a medium-grained equigranular granodiorite constituting the eastern lobe of the Los Morteros batholith, which intrudes Upper Cretaceous to lower Paleogene continental sedimentary and volcanic sequences belonging to the Cerrillos and Hornitos formations (Sergerstorm and Parker, 1959). A K-Ar date of 64 ± 2 Ma is reported for the Los Morteros batholith (Abad, 1980), and a monzogranite dike at Relincho returned a K-Ar date of 62 ± 2 Ma (Munizaga, 1996). The deposit is composed of coalesced mineralized shells associated with multiple monzogranite porphyry stocks aligned west-northwest with surface dimensions of approximately 2,000 × 700 m. Five distinct porphyry phases have been identified at Relincho including two early phases, two late phases, and one postmineral phase. These phases have similar compositions and are distinguished by textural differences, mainly whether the groundmass is aphanitic or very fine grained. Early porphyry phases are well mineralized with disseminated and vein-hosted sulfides while the later phases lack appreciable mineralized veins and disseminations. The postmineral phase is barren. Hydrothermal breccias are associated with both the early and late porphyry intrusion.

The current erosion level exposes predominantly potassic alteration, which is distinguished by hydrothermal biotite replacement of hornblende and primary biotite, and primary feldspar replaced by hydrothermal potassium feldspar. Hydrothermal potassium feldspar also forms narrow halos to some early quartz veinlets. Potassic alteration is locally overprinted by weak phyllic alteration recognized by incipient sericite replacement of primary feldspars in granodiorite and porphyry phases, along with sparse sulfide veinlets dominated by pyrite with sericite halos. The phyllic event may also be responsible for partial conversion of

primary and hydrothermal biotite to chlorite. Chlorite and epidote characteristic of propylitic alteration are ubiquitous throughout the deposit as replacements of primary minerals and in veinlets cutting all intermineral intrusions, indicating a late timing.

Crosscutting relations show evolution of veining over time beginning with early dark micaceous (EDM) bands composed of phlogopite, muscovite, quartz accompanied by abundant bornite and chalcopyrite which are cut by aplitic dikes (vein dikes), followed by biotite-sulfide veinlets, sulfide-bearing quartz veinlets, and finally pyrite-dominant sulfide veins with sericitic halos (D-type veins). Magnetite is present in some of the EDM bands and early quartz veinlets. EDM bands are distributed in equigranular granodiorite around the early porphyry stocks but are not found within them. The highest quartz vein densities are located in granodiorite immediately adjacent to the early porphyry stocks and decline outward. Termination of some quartz veinlets against early porphyry contacts suggests some veining and mineralization preceded intrusion of the early porphyry phases.

Relincho displays a typical sulfide mineral zonation from a bornite-chalcopyrite assemblage in and around the early porphyry stocks outward and possibly upward to zones of chalcopyrite and chalcopyrite-pyrite. Late porphyry phases invariably contain high pyrite to chalcopyrite ratios. Sulfide zonation is not evident in hydrothermal breccias; rather, bornite-dominant and chalcopyrite-dominant assemblages that form cement appear to be associated with discrete hydrothermal breccia-forming events.

References

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