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Oxide Mineralization at the Radomiro Tomic Porphyry Copper Deposit, Northern Chile

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Abstract

The main copper oxide minerals in the Radomiro Tomic deposit are atacamite, copper clays, chrysocolla, and copper wad. Their relative abundance provides the basis for dividing the oxide zone into two major geologic units: the Upper Oxide unit and the Lower Oxide unit. Furthermore, the study of mineral abundances in the oxide zones allowed the definition of an oxide mineral zonation that consists of five mineral assemblages, based on the relative proportion of the three main copper oxide components: atacamite, copper clays, and chrysocolla. These classifications allow both an understanding of the distribution of copper minerals throughout the zone and an interpretation of the supergene processes that formed it.

The Upper Oxide unit is mineralogically heterogeneous. The copper content is furnished, on average, by 40 vol percent atacamite, 31 vol percent copper clays with minor chysocolla and copper wad. The Lower Oxide unit is more homogeneous. Atacamite accounts for 70 vol percent of the copper ore minerals with minor amounts of copper clays and chrysocolla. Copper and chlorine concentrations and porosity are greater in the Upper Oxide unit, whereas hematite, chalcocite, and molybdenite concentrations and specific gravity are greater in the Lower Oxide unit.

The vertical distribution of the Cl/Cu ratio shows a chlorine-deficient zone located between elevations of 2,780 and 2,870 m. Between these elevations, the proportion of atacamite is lower and the proportion of copper clays, chrysocolla, and copper wad is higher than in other portions of either the Upper Oxide or Lower Oxide units.

The oxide zone at Radomiro Tomic was originated through the in situ oxidation of a preexisting secondary sulfide enrichment blanket. Oxidation produced an extensive zone of atacamite, accompanied by weakly developed argillic alteration. The upper part of the deposit was further enriched by lateral migration of copper-rich solutions to the north and east, where copper precipitated as chrysocolla, copper wad, and copper in clays. In these areas, strong argillic alteration, characterized by the presence of montmorillonite, was developed. This second alteration phase impacted only the uppermost portion of the oxide zone and the base of overlying gravels.