

La Granja Cu-Mo-Ag-Zn System: Geology and Mineral Resources

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La Granja, located in central-western Cajamarca Department, Peru, is a huge, multiphase Andean Cu-Mo-Ag-Zn porphyry/hydrothermal breccia and skarn system capable of producing copper and, potentially, Ag, Mo, and Zn at world-class levels for many decades. Over the past six years Rio Tinto has identified a zone of mineralized material on the order of >10 billion tonnes (Gt) at a grade of just over 0.5% Cu with significant levels of zinc, silver, and molybdenum. A reported inferred resource of 3.6 Gt at 0.51% Cu (at a cutoff of 0.3% Cu) was released in November 2011; however, further drilling and modeling will increase this figure substantially.

The La Granja Cu-Mo-Ag-Zn porphyry-breccia complex is hosted by several large, composite, Miocene-age intrusive porphyry stocks of dacitic to dioritic composition with numerous associated hydrothermal breccia phases. These intrusive bodies center on two main zones: one in the east named the Cerro Paja Blanca (CPB) zone and one in the west named the Mirador zone.

These composite stock complexes have intruded gently easterly dipping, Early Cretaceous- to Palaeocene-age basement sedimentary and volcanic rocks consisting mainly of andesites of the Oyotún Volcanics Formation, quartzite of the Gollarisquizga Formation, limestones, siltstones, and mudstones of the Chulec and Pariatambo formations, and andesitic pyroclastics and basaltic lava flows of the Llama Volcanics Formation. Significant amounts of Cu-Zn mineralized, chlorite- and epidote-rich skarn occur at the contact zones of the intrusive complexes with the surrounding carbonate-bearing country rocks.

The rocks in the upper levels of the intrusive porphyry and breccia complexes have undergone extensive sericitic (“phyllic”) alteration, consisting of sericite-pyrite development at the expense of almost all original minerals in the host rock. Beneath the pervasive zone of sericitic alteration exists a large zone of potassic alteration in the form of secondary biotite and lesser K-feldspar development. The potassic alteration appears to have been overprinted and destroyed by the sericitic alteration assemblages. Best hypogene copper grades occur in the potassic zone while supergene copper mineralization is almost exclusively hosted within the sericitic zone. Primary copper mineralization consists predominantly of chalcopyrite intergrown with variable amounts of pyrite. Minor amounts of bornite, digenite, tennantite-tetrahedrite, and enargite are also present. The Cu-As sulfide mineralization is believed to have formed from a later phase of more epithermal-like mineralization and is commonly associated with late-stage quartz veins at higher levels in the system. The secondary enriched zone is deeply penetrating and typically consists of “washes” of chalcocite and minor covellite over abundant pyrite crystals. The greater La Granja system of mineralized porphyry, breccias, and associated skarns defined to date covers an area of at least 3.5 km west-east by 2.5 km north-south, still open below 2,000 m from surface.

Since starting drilling in late 2006, Rio Tinto has confirmed and significantly expanded the known Cambior/BHPB resource, including discovering a new porphyry system to the west, known as the Mirador. Recent higher-grade drill intercepts in the Mirador zone suggest a block

caving resource potential which may add more than 1.5 Gt at +0.75% Cu at depths from 400 m to 2,000 m from surface. This resource is still open in several directions including at depth.