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Geology of the Collahuasi District Porphyry Copper Deposits

Glenton J. Masterman¹ and Richard L. Moore²

¹ Centre for Ore Deposit Research, University of Tasmania, Private Bag 79, Hobart, Tasmania 7001, Australia (gmasterm@postoffice.utas.edu.au); ² Toronto, Ontario, Canada

The Collahuasi district (20°58' S and 68°43' W) is located in northern Chile, 250 km southeast of Iquique. It encompasses an area of 1200 km² near the Western Cordillera, and hosts a cluster of ore bodies that currently comprise three porphyry copper deposits, associated high level epithermal veins, and paleo-gravel-hosted exotic copper deposits. The Quebrada Blanca, Ujina and Rosario porphyry copper deposits are currently in production, as well as the Huiniquintipa exotic deposit.

A joint venture between Superior Oil and Falconbridge joint venture discovered the Rosario deposit in 1979, following delineation of the Quebrada Blanca deposit in 1977. A restructured joint venture of Falconbridge, Shell Chile and Chevron, discovered the economically important Ujina ore body in 1991. Rosario (710 Mt at 0.93% Cu) and Ujina (1.22 Gt at 0.81% Cu) are jointly owned by the consortium Falconbridge (44%), Anglo American (44%) and Mitsui (12%). Quebrada Blanca (281 Mt at 1.23 % Cu) is owned 76.5% by Aur Resources, 13.5% by Sociedad Minera Pudahuel LTDA and 10% by Enami. Together, the deposits of the Collahuasi district comprise total reserves (plus production) of 2.2 Gt at 0.90% Cu .

At Collahuasi, exhumed Late Paleozoic volcanic basement is separated from Mesozoic sedimentary and volcanic rocks in the west, by the Domeyko fault system. To the east and north, Paleozoic and Mesozoic rocks are overlain by extensive Neogene ignimbrite sheets. The Quebrada Blanca (35 Ma), Rosario (34.4 Ma), and Ujina (35.2 Ma) porphyry centers, hosted exclusively within Late Paleozoic basement rocks, define a broad east-trending corridor between the Domeyko fault and the Western Cordillera. At Rosario, high-grade massive sulfide (Cu-Ag-Au) veins cut porphyry-style Cu-Mo mineralization. Similar high-sulfidation veins occur in the La Grande and Poderosa areas south and southeast of Rosario, respectively. There is a low-sulfidation Ag prospect, which comprises a 3-5 km long, semi continuous quartz vein in the Monctezuma Fault. West of Rosario, a system of paleo-channels, dissected by recent quebradas, contain isolated exotic copper ore bodies known as the Huiniquintipa deposits. Supergene copper is best developed at Quebrada Blanca and Ujina, with only limited oxide copper resources at Rosario. Supergene enrichment at Ujina formed in the middle Miocene (15.2 Ma), and was subsequently preserved by emplacement of the overlying Ujina ignimbrite (9.3 Ma).

Early chalcopyrite-bornite at Quebrada Blanca is associated with the biotite-altered monzonite stock, whereas late chalcopyrite-molybdenite-pyrite is related to cross-cutting igneous and hydrothermal breccia bodies. At Rosario, biotite-albite-K feldspar alteration + chalcopyrite-bornite-molybdenite is overprinted by zones of sericite-chlorite-pyrite-chalcopyrite. Both alteration facies are cut by pyrite-bornite-chalcopyrite-tennantite-enargite veins and associated advanced argillic alteration (pyrophyllite-alunite-dickite). At Ujina, sericite-quartz alteration, coinciding with a high-grade hypogene copper annulus (chalcopyrite), overprints K feldspar-biotite alteration in the low-sulfide (chalcopyrite-bornite) core of a monzonite intrusion. In each deposit, intrusion-centered alteration facies grade out to chlorite-epidote altered country-rocks.

The Collahuasi porphyry deposits are associated spatially with the Domeyko fault system, but their emplacement was not directly controlled by this structure. Instead, Quebrada Blanca and Ujina were intruded contemporaneously near opposite edges of the Paleozoic basement horst. Subsequent intrusion of the Rosario Porphyry into the center of the horst, suggests that emplacement was controlled by evolution of district-scale brittle structures during the late Eocene-early Oligocene.