

Discovery and Geology of La Americana and Cerro Negro: New Deep Porphyry Cu-Mo Type Mineralization at Andina Mine, Rio Blanco-Los Bronces District, Central Chile

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The critical factors that drove the exploration and discovery of two new Cu-Mo orebodies in the Andina mine area are here described. The Andina mine is part of the Rio Blanco-Los Bronces district, located in the high Cordillera of central Chile. New La Americana and Cerro Negro discoveries added more than 10 Mt Cu to the resource base of the mine and have significant implications for future brownfields exploration and geological understanding of the Miocene belt of giant Cu-Mo deposits. Firstly, both deposits are deep orebodies; there is virtually no evidence of their existence at the current surface. Secondly, they are true porphyry deposits, unlike the magmatic-hydrothermal breccias that host the ore deposits of the district, currently being mined. Finally, deep exploration has revealed different levels of exposure of the mineralized system over 1,500 m from surface, thus demonstrating the enormous potential for further discoveries with similar characteristics.

Codelco initiated a new program of brownfields exploration at Andina in 2006, particularly in areas of interest close to the existing production sectors, through a systematic geologic mapping program and revision of previous shallow drill holes. Subsequently, deep drilling was carried out to test for the continuation at depth of the high-grade breccias mined in the Sur-Sur open pit, as well as to test for possible disseminated copper mineralization in the old La Americana prospect, located 500 m to the south of the pit at an elevation of 4,000 masl (Fig. 1). Successive drilling campaigns, completed between 2008 and 2011 from surface and underground, resulted in the discovery not only of high-grade breccias, but also of porphyry-style mineralization with resources in excess of 600 Mt at 0.8% Cu + 0.02% Mo for the new La Americana deposit. This consists of a core of chalcopyrite-bornite mineralization associated with gray-green sericite alteration, hosted largely by a granodiorite with minor hydrothermal breccias and a notable absence of porphyry intrusions, surrounded laterally and above by pyrite and minor chalcopyrite shells (Fig. 1).

In 2008, almost two years after a condemnation drilling program was concluded, geologic mapping was carried out some 1,000 m east of the principal Rio Blanco underground mine and 1,000 m due north of the Don Luis pit (Fig. 1). This demonstrated the presence of outcropping propylitic alteration encompassing volcanic rocks, minor breccia bodies, narrow dacite porphyry dikes, and type D veins with sericite selvages at 3,500 masl. Review of the previous drilling, together with the experience gained at La Americana, led to these occurrences being re-interpreted as external halos of a blind porphyry system. This concept was tested by means of underground drilling and by deep drilling from surface, which started in 2009 and is still continuing. This drilling program encountered zoned porphyry-style mineralization below 2,700 masl, characterized by external pyrite-rich propylitic alteration and increasing amounts of bornite-chalcopyrite mineralization associated with potassic alteration toward the center of the

body, and occurring some 800 m below the surface outcrops that provided the initial evidence for the concept (Fig. 1). Mineralization is related to type C, B, and EDM veinlets and is hosted mainly by granodiorite and, in lesser volume, by breccia bodies. As observed at La Americana, there are no porphyry intrusions associated with the mineralization, which occurred in various stages pre-, syn-, and postdevelopment of the breccias. This new discovery, named Cerro Negro, is believed to host resources in excess of 1,000 Mt at 0.7% Cu + 0.02% Mo.

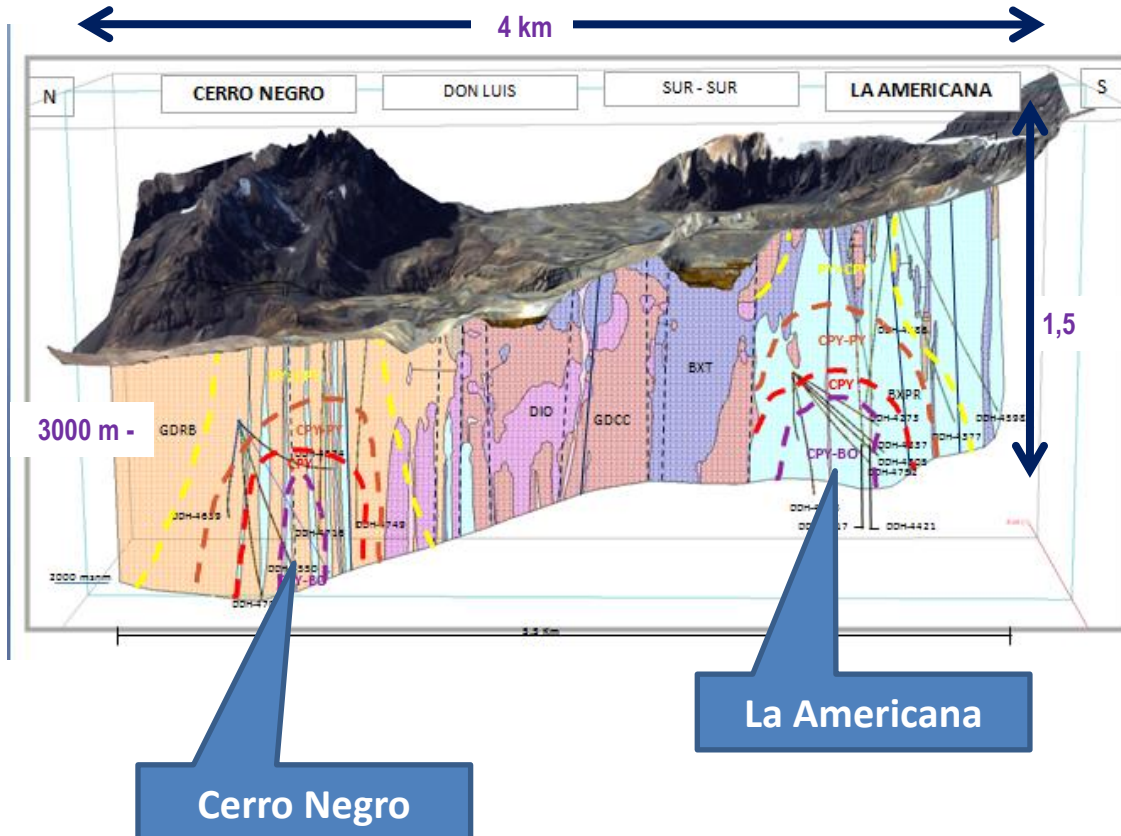


Fig. 1. Schematic section looking east, based on mine geology, showing the approximate location of the discovery drill holes at Cerro Negro and La Americana and roughly interpreted Cu sulfide zones. Abbreviations: BO = bornite, BXT = tourmaline breccia, CPY = chalcopyrite, DDH = diamond drill hole, DIO = diorite, GDCC = Cascada granodiorite, GDRB = Rio Blanco granodiorite, PY = pyrite.