



Geology and Geochronology of the Miocene Rio Blanco Porphyry Cu-Mo Deposit, Northern Peru

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Abstract

The Rio Blanco porphyry Cu-Mo deposit occurs at the north end of the Miocene metallogenic belt of northern Peru. It has a thick supergene enrichment blanket; while normal for hyperarid Chile, this is unusual in mountainous, cloud forest terrain. Rio Blanco is hosted by the Portachuela batholith. Zircon U-Pb dating shows that the youngest part of the batholith was emplaced at 12.43 ± 0.13 Ma.

The deposit formed during three magmatic-hydrothermal cycles. Cycle 1, by far the most important, occurred at 11.50 ± 0.17 to 10.92 ± 0.14 Ma (zircon U-Pb). Two intermineralization intrusions caused early potassic and propylitic alteration. This was then overprinted by a blanket of quartz-sericite, grading down into sericite-chlorite alteration. Cycle 1 was finally cut by a quartz-sericite-cemented breccia, which contains the highest-grade hypogene Cu-Mo grades. A cycle 1 molybdenite-bearing vein has a molybdenite Re-Os model age of 11.43 ± 0.16 Ma. Molybdenite Re-Os dating of the quartz-sericite-cemented breccias shows brecciation occurred at 11.28 ± 0.24 to 11.11 ± 0.18 Ma.

Cycle 2 was restricted to the east side, where narrow porphyritic dacite 1 dikes (dated by zircon U-Pb at 10.62 ± 0.16 Ma) show biotite alteration and economic copper. Cycle 3, at 10.02 ± 0.12 to 9.06 ± 0.09 Ma (zircon U-Pb), was triggered by a swarm of NE-striking quartz-plagioclase porphyry and porphyritic dacite 2 dikes. Alteration was milder, and this cycle did not introduce economic copper. Nonmineralized pebble dikes cut the system, emanating from a major diatreme, about 3×1.3 km in size, on the north side of the deposit.

The magmatic-hydrothermal history spanned about 2.5 m.y., with economic mineralization over about 1.48 m.y. However, metals were mostly introduced during cycle 1, which lasted approximately 0.58 m.y. Our work shows that while multiple magmatic-hydrothermal cycles produced Rio Blanco, sufficient metals were introduced to form a giant porphyry deposit within a single magmatic-hydrothermal cycle.

Introduction

The Miocene metallogenic belt of northern Peru and southern Ecuador includes numerous Au-rich porphyry and epithermal Au-Ag deposits (Fig. 1A). These formed between 20 and 6 Ma (Macfarlane et al., 1994; Noble and McKee, 1999; Davies, 2002; Gustafson et al., 2004; Davies and Williams, 2005; Longo, 2005; Sillitoe, 2005; Schütte, 2009; Thomas et al., 2011; Montgomery, 2012). The region includes the Hualgayoc (Longridge, 2016), Alto Chicama (Montgomery, 2012; Cerpa et al., 2013), and Cajamarca mining districts; the latter is the world's largest cluster of high-sulfidation epithermal gold deposits and includes Yanacocha (Longo, 2005; Chiaradia et al., 2009a; Teal and Benavides, 2010; Fig. 1A). Porphyry Cu-Au and high-sulfidation epithermal Au-Ag deposits have been the main focus of research, whereas descriptions of porphyry Cu-Mo deposits are relatively rare (Hollister and Sirvas, 1974; Schwartz, 1982; James, 1998; Davies and Williams, 2005; Teal and Benavides, 2010; Montgomery, 2012; Cerpa et

al., 2013). Discovered in the 1990s, Rio Blanco is in the Eastern Cordillera (Loja-Olmos domain), beside the Ecuador border, 40 km northeast of Huancabamba (Fig. 1). Our paper is the first detailed geologic description of Rio Blanco, providing an insight into a porphyry Cu-Mo deposit within an otherwise Au-rich metallogenic belt. It also provides a new exploration strategy, especially around the Peru/Ecuador border.

This article documents the geology of Rio Blanco, based on surface mapping and logging during drilling in the early 2000s, mapping of exploration adits, and recent sampling and petrographic studies of drill core. New zircon U-Pb and molybdenite Re-Os geochronology helps constrain the timing of mineralization and related intrusions.

Exploration History

With the surge in exploration in the 1990s, the Miocene metallogenic belt of northern Peru became known to mining investors worldwide. Extensive regional exploration was initiated by Newcrest Mining Ltd. in 1993. The first substantial exploration at Rio Blanco was in 1994, with geologic mapping

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