Geochemistry of the igneous rocks associated with the MMH porphyry copper deposit, Chuquicamata District, Chile

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Whole rock and trace element geochemistry, petrographic and microprobe analyses of representative samples from drill core are used to characterize, compare, and correlate various igneous bodies within the Mina Ministro Hales (MMH) deposit. MMH is a large (1,310 Mt) Cu-Mo porphyry type deposit of Eocene-Oligocene age, located 7 km south of the Chuquicamata mine. The two deposits are on opposite sides of the West Fault (aka Falla Oeste), a regional strike-slip system that truncates the Chuquicamata ore deposit in the west, and has an estimated 35 km of sinistral displacement. The host rock at MMH is a Triassic granodiorite (MM Granodiorite), intruded by the Eocene MM Porphyry (39 Ma) and MM Quartz Porphyry (36 Ma). At depth MMH contains Cu-(Mo) porphyry type mineralization and potassic alteration, with K-feldspar, green-gray sericite, and anhydrite, but at higher levels there is an overprinting by younger hydrothermal breccia bodies containing high-grade Cu-(Ag-As) ore with abundant alunite, and advanced argillic alteration (silica, alunite, pyrophyllite, sericite, and dickite). The ores are hosted by granodiorite and the various porphyries, but the genetic relationships between the high sulphidation hydrothermal breccias and the younger intrusive phases remain uncertain. Although the porphyry stage MMH is older than Chuquicamata, the high sulphidation ores may be coeval with the equivalent at Chuquicamata. MMH is being prepared for open pit mining to begin in 2013 and subsequent underground mining.

Trace element geochemistry reveals that some mineralized lithologies given different names during ca. 20 years of core logging are in fact the same rock body with different textures and degrees of alteration. Locally, K-feldspar phenocrysts formed by potassic alteration of the host mineralized granodiorite may have led to its designation as porphyry. Microprobe study suggests that part of these K-feldspar phenocrysts are of magmatic origin and grew further during potassic alteration. The MMH porphyries have age and geochemical similarities with the Fortuna Igneous Complex which is across the West Fault from Chuquicamata (same side as MMH) and also with the El Abra Porphyry Complex located east of the fault more than 35 km to the north, giving credence to the postulated left lateral displacement.

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