



## GEOLOGY OF MM: A CONCEALED PORPHYRY COPPER DEPOSIT IN THE CHUQUICAMATA DISTRICT, NORTHERN CHILE

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The MM deposit is located 5 km south of Chuquicamata and is totally concealed beneath >50 m of Miocene alluvial gravels. Hence geological understanding is based on extensive diamond drilling and underground openings.

The potential orebody comprises an elongate, semi-continuous zone that extends for 4 km from north to south, dips westwards at about 75° and attains a depth of at least 1000 m. The mineralized zone is parallel to, and delimited along its eastern side by, the West fault, a major sinistral strike-slip structure of post-mineral age.

The mineralized zone is made up of a series of steeply west-dipping panels, which from west to east comprise: (1) chloritized but pyrite-poor granodiorite, dacite porphyry dykes and roof-zone andesitic volcanic rocks; (2) weak sericite-pyrite alteration in granodiorite; (3) structurally localized sericitic and advanced argillic alteration accompanied by high-sulphidation sulphide assemblages in granodiorite; (4) a sericite-pyrite-chalcopryrite-(bornite) zone in granodiorite; (5) a sericite-chalcopryrite-specular hematite zone in granodiorite; and, abutting the West fault, (6) weakly chloritized and pyritized andesitic volcanics and, locally, red-stained but unaltered volcanoclastic sedimentary rocks. Faults, judged to be important, which juxtapose panels (3) and (4), (4) and (5) and (5) and (6) are post-mineral in timing, whereas their pre- and/or syn-mineral predecessors localized the high-sulphidation copper zones in panel (3).

The high-sulphidation zones comprise irregular stringers, stockworks, veins and patches of chalcedonic quartz accompanied by a pyrite-rich, hypogene assemblage of enargite and lesser tennantite, bornite, chalcocite, digenite and covellite.

The accompanying alteration is dominated by sericite on the hanging-wall side but by quartz-alunite ± sericite/pyrophyllite farther east. The highest copper grades, >2%, are present in the high-sulphidation zones.

The presence of these high-sulphidation zones, with some similarities to Butte-type veins, and the predominance of sericitic alteration elsewhere at MM suggest that the shallow parts of a porphyry copper system have been drilled. The limited appearance of chlorite-after-biotite and K-feldspar in the easternmost mineralized panel (5) at depths of >800 m is taken to imply approach to K-silicate alteration at deeper levels.

The MM deposit was assembled structurally as a series of fault slices, including the barren rock abutting the West fault. It seems most logical to presume that the slices were detached from the truncated western side of the Chuquicamata deposit. However, although MM and Chuquicamata geology possess similarities, especially with regard to the presence of structurally controlled, high-sulphidation zones, there are also several unexplained lithologic and alteration differences between them. Furthermore, MM lacks the well-developed supergene profile so important at Chuquicamata, and is essentially a hypogene orebody.

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