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Magmatic evolution and fertility of El Teniente Cu-district: insights from PGE and zircon geochemistry

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The El Teniente porphyry copper deposit, located in Central Chile, is one of the largest concentrations of copper in the world with ~100 Mt of copper. Magmatism at the deposit includes a large pre-mineralization intrusive complex and small pulses of felsic intrusions linked to mineralization. The wide range of magmatic compositions makes El Teniente an ideal case to study the magmatic evolution of a porphyry deposit. In this study, we use whole-rock platinum group elements (PGE) geochemistry, and zircon geochronology and geochemistry, to better understand the magmatic conditions that led to the formation of this supergiant porphyry deposit, with emphasis on evaluating the role that sulfide saturation played on magma fertility.

We have studied rock samples from the different intrusions from El Teniente district, which range in composition from gabbro (5.3 wt.% MgO) to rhyodacite porphyries (0.6 wt.% MgO). Preliminary results show that the concentrations of PGE decrease with the decrease of MgO, suggesting that sulfide saturation occurred before the MgO content of the magma fell below 5.3 wt.%. This early sulfide saturation has not affected the ability of the magmatic system to form an ore deposit, which may be because the amount of sulfide that separated from the melt was too small to have a significant effect on its copper content. However, the early sulfide saturation decreased the Au content of the magma significantly, leading to the formation of a Cu-dominated deposit, with only minor Au.

We have also determined four new U-Pb in zircon ages from regional intrusions, which overlap with the ages of the pre-mineralization and ore-bearing intrusions, showing a continuous trend in the magmatism related to El Teniente District. We will also report new zircon geochemical data from these intrusions, including trace elements concentration, oxygen and hafnium isotopes values.