RENE-2: Sistemas de Pórfidos de Cu (±Mo? ±Au) e IOCG: de la petrogénesis a la exploración

Redox conditions and metal/volatile budget of primitive arc magmas at 35.5°S: Implications in the generation of the Mio-Pliocene copper belt in Central Chile

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At global scale, prominently mineralized porphyry copper systems (>40 Mt Cu) occurs exclusively along thick crustal segments (>40 km) of active continental margins. Specific magmatic and hydrothermal processes have been invoked to explain the deposition of sulfide ore involving Cu and Au that constitute huge metal accumulations in the shallow crust. The processes operating to form such metal and sulfur anomalies occurs during discrete "time-space windows" in the long-term history of a magmatic arc. The processes that allow the large-scale transport of sulfur and highly chalcophile elements (Cu-Au) to the upper crust are matter of debate. There is, yet, consensus that redox conditions are a first order factor controlling the behavior of metals through sulfur speciation in the primitive melts intruding the deep crust. Although it is widely recognized that arc basalts may be more oxidized compared to those from other tectonic environments, it is not clear whether these differences reflect the mantle source condition (Kelley & Cottrel, 2009), or they represent magma oxidation during ascent in the crust (Lee et al, 2005). In the first case, sulfide crystallization would be inhibited given the occurrence of sulfur dominantly as the oxidized form (S^{+6}). Contrary, in the latter case, sulfide precipitation (S^{-2}) would be dominant during the early differentiation, depleting the residual magmas in metal and sulfur. Given the intense hydrothermal alteration and the scarcity of mafic rocks in porphyry environments, it is not possible to constraint *in-situ* the initial magmatic redox conditions. We use the primitive mafic melts preserved in Los Hornitos volcano (35.5°S) as the closest time-space *proxy* to explore the redox conditions, as well as, the metal/volatile endowment of arc magmas in a metal-fertile segment of the Andes; providing insights into the state of the subarc mantle underneath the Mio-Pliocene belt, which generate two of the world-largest porphyry Cu systems, El Teniente and Río Blanco-Los Bronces. We interrogated melt inclusions contained in high-forsterite olivine crystals (88<Fo<92) with µ-XANES and combined EPMA, SIMS and LA-ICPMS analysis, to investigate the speciation of sulfur and major and trace element components. Results confirm oxidized conditions compared with basalts from other tectonic settings coupled to higher H_2O and S contents (up to ~4% and ~5500 ppm respectively) contrasted to available volatile data reported for the Southern Andes.