

In situ geochemical and isotopic signature of pyrite as a proxy for fluid sources in the Candelaria-Punta del Cobre IOCG district, Chile

IRENE DEL REAL^{1,*}, JOHN THOMPSON¹, ADAM C. SIMON², MARTIN REICH³

¹ Earth & Atmospheric Sciences, Cornell University, Ithaca, NY, USA.

² Department of Earth & Environmental Sciences, University of Michigan, Ann Arbor, MI, USA

⁴ Department of Geology and Andean Geothermal Center of Excellence (CEGA), University of Chile, Santiago, Chile
(*) id92@cornell.edu

Pyrite is ubiquitous in the world-class iron oxide-Cu-Au (IOCG) deposits of the Candelaria-Punta del Cobre district. It is documented from early to late stages of alteration and mineralization, and observed in deeper and shallow levels of the mineralized ore bodies. Despite its abundance, the chemical and isotopic variations of pyrite at Candelaria remain unknown. Here we present the first pyrite geochemical dataset in samples collected throughout the district. These were used to characterize and constrain the nature of mineralization. Synchrotron-XRF elemental maps of pyrite grains show a strong zonation of Co, Ni, As and Se, and Co/Ni ratios that suggest a mafic affinity. In situ $\delta^{34}\text{S}$ values measured using SIMS range between -2 to +10‰, with most analyses ranging between -1 to +2‰, which points to predominantly magmatic source for sulfur. Se/Co ratios in pyrite correlate with the $\delta^{34}\text{S}$ data, suggesting redox changes of the hydrothermal fluid that are recorded at the grain scale. These redox variations also correlate with the occurrence of different Fe oxides observed in the district, which include magnetite, mushketovite, specularite. Se/S vs. $\delta^{34}\text{S}$ data, on the other hand, show that the main-stage mineralization has a magmatic signal, while the late-stage mineralization has a more basinal signature. Our results indicate that the hydrothermal fluids responsible for mineralization in the Candelaria-Punta del Cobre district are unequivocally of magmatic-hydrothermal origin, with a late incursion of basin-derived fluids occurred that precipitated additional sulfides in the system.