The trace element signature of pyrite from the Los Colorados iron oxide apatite (IOA) deposit: A missing link between IOA and IOCG systems?

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The link between IOA and IOCG deposits remains controversial. Based on geochemical and isotopic data of magnetite from the Los Colorados IOA deposit in northern Chile, we have recently reported compelling evidence for a change from purely magmatic to magmatic-hydrothermal conditions that agrees with the proposed model in which IOAs may represent the deeper roots of some Andean IOCG systems. Our model [1] invokes concentration of magnetite that takes place by buoyant segregation of early-formed magmatic magnetite-bubble pairs, followed by high-T hydrothermal magnetite formation, driven by decompression.

Here we provide new geochemical data in accesory pyrite at Los Colorados that supports this model and provides new insights on the trace metal budgets in IOA deposits. Pyrite at Los Colorados is related to the hydrothermal stage, has low modal abundances (<1%) and can occur as corroded crystals engulfed by hydrothermal magnetite. Electron microprobe analyzer (EMPA) data show high Co and Ni concentrations (~ up to 4 wt% and ~1-2 wt%, respectively) and relatively low As contents (100's ppm level, in few cases up to ~1000 ppm). When combined with secondary ion mass spectrometry (SIMS) spot analyses, pyrite data show significant amounts of Cu (10-100 ppm levels, occasionally ~1 wt%) and Au (up to 1 ppm, occasionally 100's ppm).

These results suggest a link to mafic-intermediate magmas and are indicative that IOA deposits can source Fe-Cu-Au-rich fluids that according to experimental studies [2], can migrate and cool to form IOCG mineralization at shallower levels in the crust.

[1] Simon, Reich *et al* (2014) Iron and oxygen isotope and element systematics of magnetite from the Los Colorados IOA deposit, Chile: A paradigm shift for IOA deposits? SEG-Keystone, Colorado. [2] Simon *et al* (2004) Magnetite solubility and iron transport in magmatic-hydrothermal environments. *GCA* **68**, 4905–4914.