

## **An investigation of the chemistry of apatite in iron oxide-apatite (IOA) deposits**

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Iron oxide–apatite (IOA) deposits are an important source of iron ore and there is growing interest in them as rare earth element (REE) resources owing to the REE enrichment of apatite. Globally, IOA deposits are found in districts that are associated with subduction zone environments and the accompanying arc volcanism and back arc spreading that occur in these tectonic settings. IOA deposits are typically dominated by magnetite, with lesser hematite that may be secondary, and varying amounts of apatite and actinolite. Despite significant research aimed at understanding the genesis of IOA deposits, there is no consensus on how the deposits formed. Working hypotheses include formation by either magmatic-hydrothermal replacement, hydrothermal precipitation similar to iron oxide copper gold (IOCG) deposits, magmatic liquid immiscibility, or flotation of magmatic-hydrothermal magnetite suspensions. In this study, we are quantifying the major, minor and trace element chemistry of apatite from the Los Colorados IOA deposit, located in the Chilean Iron Belt. Apatite is a ubiquitous phase in IOA deposits, and it is likely that the major, minor and trace element chemistry of apatite will elucidate the processes involved in the formation of Los Colorados and IOA deposits in general. Apatite has the ability to incorporate nearly half of the elements in the periodic table; therefore, studies of the bulk and trace element composition of apatite grains should allow researchers to determine the fluid history. An understanding of the fluid history allows researchers to identify the fluids responsible for the precipitation of the ore minerals and by extension, source reservoirs for the ore deposit. Preliminary studies of apatite grains in samples from the Los Colorados deposit were done using an electron microprobe and a field emission scanning electron microscope equipped with a cathodoluminescence (CL) detector. The data reveal concentration variations between the core and rim of the apatite grains for elements such as chlorine (Cl). The variations in Cl concentration also correlate with variations in CL in the apatite grains. Since CL in apatite is indicative of the presence of REE and manganese, these results may indicate that hydrothermal fluids are integral to the formation of this deposit. More work is required to determine whether these results support or refute the previously proposed models of formation for IOA deposits.