The Chemistry and Textures of Magnetite from the Candelaria IOCG Deposit and Quince IOA Prospect in the Chilean Iron Belt

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Iron oxide - copper - gold (IOCG) and iron oxide - apatite (IOA) deposits are important sources of many strategic metals, including Cu, Au, Fe and rare earth elements (REE), and also Ag, U, Ba and F in some deposits. Both deposit types contain abundant Fe-oxides (i.e., magnetite in IOAs, and magnetite and hematite in IOCGs), which are the modally dominant geochemical anomalies in both deposit types. Sodic-calcic alteration is also extensive in both deposit types and varies from weak to pervasive among deposits. Mineralization in both deposit types is structurally controlled, and the seemingly ubiquitous spatial and temporal association of IOCG and IOA deposits has led some to suggest a genetic connection between the two deposit types, where S-Cu-Au-poor IOA deposits represent the barren, deeper levels of S-Cu-Au IOCG deposits. Numerous hypotheses regarding the source of metals and fluids involved in their genesis have been proposed, from a purely magmatic origin (i.e., liquid immiscibility), to a model that invokes mixing of magmatic and surface (evaporitic) hydrothermal fluids. In this study, we focus on the world class Candelaria IOCG deposit, and the Quince IOA prospect, both in the Chilean Iron Belt. We used an electron probe microanalyzer (EPMA) to investigate the chemistry and textures of magnetite in samples from drill-cores from both deposits. For the Quince samples, back scattered electron (BSE) imaging revealed three types of magnetite: pristine magnetite without detectable inclusions or lamellae; magnetite that contains abundant ilmenite exsolution lamellae; and, magnetite rich in mineral inclusions. Fe-Ti oxides, mainly ilmenite (and rutile to a lesser extent), are present along grain boundaries, and filling interstices between magnetite grains. Magnetite grains also commonly meet at triple junctions. The BSE imaging of magnetite from Candelaria revealed at least two types of magnetite textures: "tabular" magnetite with oscillatory zoning; and, fairly pristine, un-zoned magnetite. The textures of magnetite from both deposits are consistent with syn- or post-mineralization dissolution-reprecipitation, re-equilibration processes. The EPMA data reveal that [Ti + V] and [Al + Mn] concentrations systematically decrease from core to rim within individual magnetite grains, which indicates a cooling trend for magnetite growth. The combined chemical and textural data are consistent with the interpretation of a strong hydrothermal influence for the origin of both deposits.