IOCG Systems: Are They Just a Problem of Ore Traps?

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IOCG mineralization encompasses a range of hydrothermal deposits that share the presence of magnetite and hematite along with variable amounts, if present, of chalcopyrite and gold. Hydrothermal alteration, relationships with igneous rocks and structures, and origin of fluids varies between districts. A systematic study of the major IOCG belts suggests that the so-called IOCG deposits embrace a wide range of types of mineralization with no genetic connection; most deposits are formed by fluid-rock interactions overprinting already emplaced rocks during a metasomatic process geochemically similar to that of skarns. The mineralization is often formed by (a) reaction with magnetite-bearing shear zones as well as previous ironstones and magnetite-(apatite) rocks along structures; (b) skarn-like stratabound replacements of Si-Al-Ca–rich rocks (usually volcanic) with a zonation from feldspar+actinolite±biotite to actinolite/biotite rocks when in mafic rocks and feldspar-tourmaline when in felsic rocks; (c) shear zone-related alteration of equivalent rocks.

The hydrothermal fluids are very likely high temperature (ca. >400°C) and alkaline, equilibrated with Si-Al-rich intermediate rocks, and form the IOCG system at rather high rock/fluid ratios. Reactions with a previous ironstone destabilizes the Cu-Au-bearing complexes and can produce the Cu-(Au) mineralization. Reaction with intermediate-felsic volcanic rocks alone is not able to produce a significant change in fO_2 and pH and we suggest that fluid-rock interaction with reactive rock traps or fluid mixing with basin-derived water is the main mechanism of ore formation in the stratabound IOCG mineralization. Further cooling and oxidation when circulating along shear zones likely leads to the precipitation of low-temperature assemblages with hematite, white mica, chlorite, and carbonates. When the sequence hosts calc-silicate hornfels or limestone, skarns rich in garnet can form.

Our hypothesis is that IOCG systems can form in relationship with any magmatic-hydrothermal system related to intermediate intrusives and do not need a unique geodynamic scenario for their formation.