A Genetic Link between Iron Skarn Mineralization and IOA deposits

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Iron oxide-apatite (IOA) deposits represent subvolcanic ore bodies composed mostly of magnetite, hematite, and apatite +/- minor REE-bearing minerals. Subvolcanic igneous intrusions and fluids play a critical role in the formation of IOA deposits. Fluids can also modify the texture and composition of IOA minerals during post-emplacement, fluid-rock interaction. Fluid inclusion studies of the IOA deposits from the Middle-Lower Yangtze River Metallogenetic Belt (MLYRMB), eastern China indicate that ~800 °C hypersaline fluids (up to 90 wt.% NaCl eq.) were present during their genesis (Li et al. (2015) Ore Geol Rev 67, 264). As such high-temperature fluids cool down, they would modify the IOA ore minerals via auto-metasomatism and/or fluid exchange with deep-seated meteoric waters and surrounding country rock fluids. One result of this interaction could be the lower temperature iron skarns (~400 °C) spatially associated with a number of IOA deposits.

One example of such a relationship is a newly identified subsurface IOA ore body located at the apex of a subvolcanic diorite porphyry intursion, which is associated with near surface iron skarn ore bodies from the Daye district, MLYRMB, eastern China (Hu et al. (2019) GSA Bull, in press). The IOA ore body consists mainly of Ti-enriched magnetite (ilmenite lamellae) and variable amounts of fluorapatite, diopside, and actinolite, which is distinctly different from the nearby iron skarn ores, which contain mainly Ti-depleted magnetite with oscillatory growth zones along with subordinate garnet, chlorite, calcite and pyrite. Titanite and fluorapatite from the IOA ores yield a U-Pb age of 129.5 ± 3.0 Ma to 132.5 ± 2.3 Ma, which are within the error bars of the titanite U-Pb age for the associated iron skarn ores (132.5 ± 1.5 Ma), and are consistent with a zircon U-Pb age for the ore-hosting diorite porphyry (130 ± 1 Ma). This age consistency supports a genetic link between the diorite porphyry, the IOA ore body, and the iron skarns. This in turn suggests that the IOA ore body and iron skarns are the products of different mineralization stages from a single evolved hypersaline fluid originating from the magmatic diorite porphyry intrusion. It implies that iron skarn deposits on the surface can be used as an exploration tool for subsurface IOA deposits both on a local and regional scale.