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Origin of the Magnetite-(Apatite) and IOCG Deposits of the Coastal Cordillera of the Andes

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The Andean Coastal Range between Santiago (Chile) and Lima (Peru) hosts dozens of magnetite-(apatite) (MtAp) and iron oxide-copper-gold (IOCG) deposits, forming one of the major clusters of these styles of mineralization. Both of them are related to an Upper Jurassic-Lower Cretaceous magmatism. The MtAp mineralization is always located in extensional zones within arc-parallel strike-slip faults and is characterized by the presence of massive magnetite-actinolite/diopside-apatite mineralization, many times capped by a pegmatite. IOCG deposits replace mafic volcanoclastic rocks or the previous MtAp mineralization; the assemblages are somewhat similar but have no apatite and are sometimes enriched in sulfides, including chalcopyrite, pyrite, and bornite. Vertically, they evolve into quartz-calcite-sulfide–rich veins.

In southern Peru, Marcona hosts significant magnetite mineralization crosscutting the basement, with massive tabular orebodies showing magmatic relationships with coeval dacitic dykes; vertically, it evolves into a massive diopside-apatite pegmatite. Above the Precambrian-Mesozoic unconformity, the giant orebodies of Marcona Cobre and Mina Justa host dominantly stratabound IOCG mineralization. The nearby MtAp Hiero Acarí deposit is located along subvertical tensional veins hosted by quartz-diorite; here magnetite-rich parts alternate with actinolite-magnetite-apatite pegmatite zones. In both cases, mineralization is hosted by a wide aureole of Ca-Fe-K hydrothermal alteration. Locally, stratabound IOCG-like mineralization alternates with large calcic and magnesial skarns. .

Radiogenic isotope geochemistry indicates significant crustal contamination in both types of deposits. MtAp rocks seem to be derived from contaminated magmatic systems but inherit a significant mantellic Nd signature; IOCG deposits track a more crustal derivation. Preliminary geochronology confirms that major MtAp mineralization took place around 165-154 Ma, with IOCG mineralization ca. 20 Ma later. However, there's a discrepancy in ^{40}Ar-^{39}Ar dating, suggesting a complex hydrothermal evolution for the mineral systems.