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Title: THE GIANT MESOZOIC MARCONA - MINA JUSTA IRON-COPPER DISTRICT, SOUTH-CENTRAL PERÚ: IMPLICATIONS FOR THE GENESIS AND DEFINITION OF “IOCG” MINERALIZATION

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Abstract: The wider Marcona district of littoral south-central Perú represents the largest concentration of iron oxide-copper-gold deposits in the Central Andes, with reserves and past production of over 1940 Mt grading 55.4 percent Fe and 0.12 percent Cu at Marcona and 346.6 Mt at an average grade of 0.71 percent Cu, 3.8 g/t Ag and 0.03 g/t Au at the 3-4 km distant Mina Justa prospect. Hydrothermal activity occurred episodically from 177 to 95 Ma and was controlled by NE-striking faults transecting a Middle Jurassic andesitic shallow-marine arc and a succession of Late Jurassic to mid-Cretaceous volcano-sedimentary basins.

At Marcona, emplacement of a swarm of massive magnetite orebodies with subordinate, overprinted magnetite-sulfide assemblages, coincided with a 156-162 Ma episode of uplift of the Jurassic arc, but mineralization is hosted largely by underlying albitized Lower Paleozoic metaclastic rocks. The magnetite orebodies exhibit smoothly curving, abrupt contacts, dike-like to tubular apophyses and intricate, amoeboid interfingering with dacite porphyry intrusions, interpreted as evidence for the commingling of hydrous Fe oxidic and silicic melts. An evolution from magnetite-biotite-calcic amphibole to magnetite-phlogopite-Ca amphibole-sulfide assemblages coincided with quenching from $>700^{\circ}\text{C}$ to $<450^{\circ}\text{C}$ and with the exsolution of aqueous fluids with magmatic isotopic compositions ($\delta^{34}\text{S}=+0.8$ to $+5.9$ per mil; $\delta^{18}\text{O}=+8.5$ to $+12.9$ per mil). Subsequent, lower-temperature, chalcopyrite-pyrite-calcite±pyrrhotite±sphalerite assemblages were deposited from fluids with similar $\delta^{34}\text{S}$ ($+1.8$ to $+5.0$ per mil), but a wider range of $\delta^{18}\text{O}$ values ($+1.7$ to $+14.5$ per mil).

The much younger (95-104 Ma) hydrothermal Mina Justa Cu(-Ag) deposit is hosted by Middle Jurassic andesites intruded by small dioritic stocks at the faulted SW margin of an Aptian-Albian volcano-sedimentary basin. Intense K-Fe metasomatism preceded the deposition of magnetite-pyrite assemblages at 500-600°C from fluids with a magmatic signature $\delta^{34}\text{S} = +0.8$ to $+3.9$ per mil; $\delta^{18}\text{O} = +8.3$ to $+11.4$ per mil). In contrast, ensuing chalcopyrite-bornite-digenite-chalcocite-hematite-calcite mineralization was the product of non-magmatic, probably evaporite-sourced, brines with $\delta^{34}\text{S}$ of $+29$ per mil and $\delta^{18}\text{O}$ of -7.4 to $+5.9$ per mil.

Marcona and Mina Justa, although contiguous, represent contrasted ore deposit types, the former dominated by iron oxide melts which vesiculated in the shallow crust to form minor Cu(-Zn) sulfides, and the latter a hydrothermal system recording the incursion of fluids plausibly expelled from an adjacent basin. Non-magmatic sulfur similarly dominated Cu(-Au) ore formation in all large exocontact Central Andean IOCG deposits with economic Cu sulfide facies, viz. La Candelaria Punta del Cobre, Mantoverde and Raúl-Condestable. An Andean perspective indicates that “Kiruna-” or “Chile-type” magnetite-dominated deposits should be excluded from the IOCG ore deposit clan.