

THE ORIGIN OF HEMATITE IN HIGH-GRADE IRON ORES BASED ON INFRARED MICROSCOPY AND FLUID INCLUSION STUDIES: THE EXAMPLE OF THE CONCEIÇÃO MINE, QUADRILÁTERO FERRÍFERO, BRAZIL

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**Abstract**

Petrographic and textural analysis combined with fluid inclusion studies by infrared microscopy of high-grade (>65% Fe) hematite ore samples from the Conceição deposit, in the northeastern part of the Quadrilátero Ferrífero, Brazil, indicate a complex process of oxidation and mineralization during two orogenic events, each developed under different conditions and involving distinct fluids. The earliest mineralization formed massive magnetite-rich orebodies under relatively reducing conditions in the early stages of the Transamazonian orogeny. Magnetite was oxidized (martitized) with the development of porous hematite crystals (hematite I). Possibly during this stage, new hematite crystals were also formed from low-temperature, low- to medium-salinity fluids, as indicated by two-phase fluid inclusions. The origin of these fluids is still uncertain but tentatively interpreted as being modified surface water. The fluids were transported along normal faults and fractures during post-tectonic collapse following the Transamazonian orogeny (2.1–2.0 Ga) and creation of the dome-and-keel structural pattern of the Quadrilátero Ferrífero. These solutions were also likely responsible for the initial oxidation of the iron formations and the development of hematite I. Subsequent uplifted hot basement rocks or post-tectonic plutons were probable heat sources for the regional metamorphism and development of a granoblastic fabric of hematite II grains in the iron formations and high-grade orebodies. However, the ore was only partially recrystallized, as several relics of the early magnetite, martite, and hematite are still preserved in the granular hematite II crystals. During the Brasiliano-Pan-African orogeny (0.8–0.6 Ga), high-salinity fluids, with temperatures varying from ~120° to a maximum of approximately 350°C, penetrated the iron formations along shear zones, crystallizing initially tabular and thereafter platy hematite crystals (hematite III and specularite) forming schistose orebodies. Quartz veins that cut across the ore and envelop specularite plates and ore fragments formed from late-stage, high-temperature, and low-salinity fluids containing CO<sub>2</sub>. These later fluids did not alter the ore.

Each of these stages of mineralization produced orebodies with distinct features. Recurrent hydrothermal mineralization is thought to have been responsible for the development of giant, high-grade iron ore deposits in structurally favorable sites. Fold hinges with enhanced permeability and deep faults able to conduct the fluids to the surface, repeatedly over time, should be important targets for exploration of new resources.

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