

Genesis of High-Grade Hematite Orebodies of the Hamersley Province, Western Australia

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Abstract

The Hamersley iron ore province of Western Australia contains world-class high-purity hematite orebodies hosted within Lower Proterozoic banded iron formations at Mount Tom Price, Mount Whaleback, and Paraburdoo-Channar. New evidence indicates that the orebodies are structurally controlled along old normal fault systems that formed during a period of major uplift and extension in Proterozoic times. Hematite ores are always hosted by the Brockman Iron Formation, and ore formation resulted from a multistage, sequential removal of gangue minerals from the host, giving rise to residual concentration of iron.

The first, hypogene, stage of ore formation removed silica only, leaving a thinned residue enriched in iron oxides, carbonates, magnesium silicates, and apatite, with no apparent change in the oxidation state of the iron minerals. In this stage of alteration, warm, highly saline bicarbonate-saturated fluids from the underlying carbonate-shale Wittenoom Formation leaked upward along fault zones into the lower part of the Brockman Iron Formation. During the second, deep meteoric, stage of ore formation a magnetite-siderite assemblage oxidized to hematite-ankerite, characteristic microplaty hematite developed, and magnetite converted to martite. The fluid responsible was moderately warm, of low salinity, and oxidized, and it most likely derived from the surface. A second stage of gangue removal followed this oxidation stage and stripped all carbonate from both magnetite and hematite zones, leaving highly porous and permeable iron ore bands with a high apatite content interbedded with magnesium-rich shale bands. The final, purely supergene, stage of upgrading is indistinguishable from modern weathering but penetrated deep below the present surface. Magnesium silicates were converted to a kaolinitic residue, greatly thinning the shale bands, apatite was destroyed, and both calcium and phosphorus were leached from the ore. The final product is a highly porous hematite ore of characteristic microplaty texture interbedded with kaolinitic shale containing a significant amount of aluminum and titanium, which retain their relative proportions throughout the upgrading process.