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The Genesis of the Hope Downs Iron Ore Deposit, Hamersley Province, Western Australia

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Abstract

The banded iron formation (BIF)-hosted Hope Downs high-grade hematite ore deposits are situated within the Marra Mamba Iron Formation with subsidiary deposits in the Brockman Iron Formation of the Archean to Proterozoic Hamersley Group of Western Australia. The main orebody extends to 260 m below the surface and is unusually rich in martite (pseudomorphous hematite after magnetite) and poor in limonite and goethite compared to other ore deposits of the Marra Mamba Iron Formation. The high-grade hematite ore is mainly within the Newman Member but also occurs in parts of the Nammuldi Member together with low-grade limonitic ore that becomes high grade after calcining. Karst erosion of the overlying Wittenoom Formation has produced steep-sided buried valleys adjacent to the in situ orebodies that contain thick deposits (<160 m) of goethitic and sideritic sediments, including remnants of Robe Pisolite Formation, bedded siderite, hematite gravels, red ochreous detrital material, and enriched scree deposits that are additional sources of ore.

The ore consists of low phosphorous martite-limonite-goethite derived from chert-free BIF by supergene weathering. No evidence of the complete carbonate replacement of chert has been found at Hope Downs nor were any traces of preexisting chert bands seen in the ore, despite the abundance of chert bands in BIF elsewhere. A variety of textures and composition shown by cherty BIF adjacent to the orebodies is described from which the origin of the chert-free BIF is inferred, including sedimentary structures consistent with density-current deposition.

A model is presented for the origin of the host iron formation and the ore deposits, in which density currents transported reworked iron silicates and hydroxides in colloidal suspension onto an unstable sea floor. The amorphous silica produced during diagenesis of Al-poor iron silicates formed the characteristic chert bands of BIF but some of the hydrous amorphous silica was lost prior to lithification to form chert-free BIF. Weathering of the chert-free BIF produced the high-grade hematite ore that is exposed today.

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