

Hypogene Alteration as a Precursor to Supergene Enrichment—A New Style of Iron Ore Mineralization in the Pilbara, Western Australia

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Exploration at BHP Billiton's Marillana and Mindy deposits in the northern Hamersley Province identified a number of atypical features in the normally consistent Hamersley Group rocks. These anomalous features included reduction in natural gamma response of the rocks, extensive silicification (manifested as quartz breccias), siderite alteration, and variations in whole-rock geochemistry from the typical Hamersley Group characteristics.

Investigation of these deposits through surface mapping, drill hole logging, geochemical analysis, petrographic examination, structural interpretation, and 3-D modeling revealed a geological history distinctly different from the rest of the Hamersley Province.

Following the main tectonic events in the Hamersley Province, it is interpreted that hydrothermal fluids moved along the regional-scale Poonda fault. Initially, the fluid silicified the Hamersley Group rocks with the development of extensive hydrothermal silica-rich breccias which are possibly related to the development of other chert-rich breccias in the Eastern Pilbara. Following the initial silicification, the fluid evolved, possibly through interaction with underlying carbonate-rich units, resulting in extensive siderite and minor pyrite alteration of rocks adjacent to the Poonda fault. These events often resulted in complete alteration of the rocks in the Brockman Iron Formation, Mt. McRae Shale, and Mt. Sylvia Formation to the point where the primary lithology (banded iron formation, shale, or chert) is unrecognizable.

Later supergene fluids, likely during the Mesozoic, resulted in weathering of the siderite-altered rocks into massive, relatively homogeneous bodies of goethite with only minor hematite. This is in addition to the more typical martite-goethite enrichment developed in the banded iron formations, combining to make BHP Billiton's Marillana deposit one of the largest iron deposits in the Pilbara.

Supergene enrichment formed from massive whole-rock siderite alteration has not been previously identified in the Hamersley Province and represents a new style of iron deposit for the region.