

Inversion of the Ashburton Basin Margin and Structurally Controlled Hypogene Iron Ore Deposits of the Hamersley Basin

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The Neoproterozoic to early Paleoproterozoic Hamersley basin in NW Australia is dominated by banded iron formation (BIF) and hosts numerous world-class, structurally controlled iron ore deposits. Previous workers have subdivided these major BIF-hosted deposits into two types: Middle Paleoproterozoic hypogene (e.g., Mt. Tom Price, Mt. Whaleback, Paraburadoo) and Tertiary supergene (e.g., Area C, Hope Downs). They also invoked contrasting structural environments for each; however, these can be unified across the province and related to inversion along the younger middle Paleoproterozoic Ashburton basin margin.

Clasts in conglomerates of the upper and lower Wyloo groups (composing the lower Ashburton basin) illustrate the timing of mineralization relative to deformation. BIF clasts occur in conglomerates at the unconformable base of the lower Wyloo Group, which truncates older NW-trending extensional faults. These sediments were followed by mafic volcanic rocks (ca. 2209 Ma), then dolomite prior to the Ophthalmian deformation (ca. 2150 Ma). Mineralized clasts occur within the basal conglomerate of the Mt. McGrath Formation (upper Wyloo Group), disconformably overlying this sequence.

Mineralization is located either (1) within Ophthalmian synclines and associated reverse faults (e.g., Area C, Hope Downs), (2) within steep NW-SE-trending faults, or (3) within the hanging wall of sequential or discrete inverted Paleoproterozoic grabens (well represented at Brockman 4 and Paraburadoo), partitioned above the carapace of preexisting Archean domes, and localized along related structures. Those grabens are typically bounded by steep NW-SE-trending faults, conjugate steep NE-trending faults, and E-W-trending, relatively shallow extensional faults (ca. 45–55°—near bedding-parallel) that typically remove stratigraphy (usually bedded dolomite of the Wittenoom Formation) and are sometimes reactivated as dome-verging thrusts repeating stratigraphy. Structural vergence of the grabens is controlled explicitly by the orientation of the underlying dome carapace.

In the western and central part of the province, the system maintains normal displacements with stratigraphy removed across the dome-verging E-W structures and rare refolding and stratigraphic repeats indicating inversion. In the east, compressional structures dominate, perhaps related to inversion, with reclined to overturned regional-scale Ophthalmian folds developed in the hanging wall of those same dome-verging E-W-trending ramps, interpreted as thrust faults on the basis of capping recumbent anticlines, but typically with overall normal displacement. Inversion of these discrete grabens and the coincident inboard development of fold-thrust geometries correspond to the Ophthalmian Orogeny, herein related to compressive reactivation along the Ashburton basin margin. Mineralization occurred late in or immediately after that compressional deformation. We present new data and, with reference to these, a reassessment of accepted ore deposit models in the Hamersley basin with implications for other correlated terranes.