

The Structural Evolution and Hypogene Origin of the Nyidinghu Iron Ore Deposit, Hamersley Province

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The Nyidinghu iron ore deposit is located in the relatively undeformed north of the Hamersley province. Nyidinghu comprises a resource of 1,760 Mt of Paleoproterozoic Brockman Iron Formation-hosted bedded iron martite-goethite (M-G) mineralization, and 680 Mt of Miocene channel iron mineralization (not discussed here). M-G mineralization is usually modeled as the product of supergene processes of Cretaceous-Paleogene age.

The deposit occurs beneath alluvial cover at the outfall of Weeli Wolli Creek into the broad Fortescue Valley with little significant outcrop on Fortescue's tenure. Geological interpretation here is mainly based on detailed drilling and geophysical surveys (airborne magnetics and EM, ground gravity), with only limited mapping.

Mineralization is strongly controlled by the subvertical to steep SE-dipping, NE-striking faults of the Weeli Wolli fault zone and is bounded to the north by the NW-striking regional Poonda fault. M-G mineralization is well developed from surface to over 330-m depth. The 1- to 2-km-wide Weeli Wolli fault zone is a reactivated elongate graben comprising a number of subparallel splays with apparent vertical movements of up to 400 m.

The interpreted structural evolution of the Nyidinghu deposit is as follows: (1) development of proto-Weeli Wolli fault zone within underlying Pilbara craton greenstone terrane during the Mesoarchean; (2) deposition of the Neoproterozoic Hamersley Group with the proto-Poonda growth fault defining major lateral facies changes, including proximal development of carbonate turbidites in normally BIF- and/or shale-dominant strata; (3) reactivation of the Weeli Wolli fault zone by ongoing basement gravity-driven vertical tectonics (Rocklean Movement); (4) pre-Wyloo Group-related extensional faulting along the southern margin of the province; (5) Ophthalmian (ca. 2145 Ma) south-over-north compression locally taken up by oblique sinistral strike-slip movement along the Weeli Wolli fault zone and SE-verging fault-related folding; (6) late Ophthalmian extension and inversion of Weeli Wolli fault zone to a graben; (7) regional Mesoproterozoic extension resulting in north-block-down movement of Poonda fault; and (8) emplacement of 755 Ma dolerite dike.

Mineralization hosted by the Weeli Wolli fault zone continues on to third party tenure, with potentially 3 Bt of mineralization within the Weeli Wolli fault zone, making it arguably the single largest discrete structurally controlled mineralizing system in the province.

The Weeli Wolli fault zone is the northernmost of a series of NE-orientated post-Ophthalmian extensional faults developed in the SE Hamersley. Toward the SE, the apparent displacement of the faults increases and orientation progressively flattens to shallow SE dipping. Splays off these faults host both significant microplaty hematite and M-G mineralization (e.g., Whaleback, Hope Downs 4). Targeted petrography of goethite-poor samples from Nyidinghu delineated local zones containing microplaty hematite more recently modeled as due to late Ophthalmian hypogene fluids.

We argue that the very strong structural controls, depth of mineralization, degree of endowment, and local microplaty hematite development are compatible with early fluid flow along the Weeli Wolli fault zone and/or Poonda fault to produce localized microplaty hematite mineralization and associated alteration which were preferentially overprinted during the Cretaceous-

Paleogene supergene mineralizing event. The original extent of the early system is unknown due to the extensive overprinting.