The Savage River Magnetite Orebodies: Structural and Textural Clues to the Origin of Tasmania's Largest Metal Deposit

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The Savage River magnetite orebody is the largest metalliferous deposit in Tasmania, with a pre-mining tonnage exceeding 371Mt @ 31.9% Fe (MRT). Yet during almost 50 years of mining, it has attracted little geological research. Efforts to increase geological knowledge of the deposit by ABM Ltd, led to Nic Turner's consulting work. This seminal study provided the foundation for a collaborative project between the company and CODES, aimed at understanding the structural history of the mine. Independently, petrological and geochemical studies of the mine host rocks were undertaken. The combined efforts have shed considerable light on the structural history and possible origin of this enigmatic deposit.

The >6-km-long deposit comprises multiple northeast-trending magnetite-serpentine-talc-carbonate lenses, hosted in deformed and metamorphosed Cambrian (510 ± 10 Ma) high-magnesium mafic metavolcanic, and metasedimentary rocks. The host sequence is intensely folded and highly strained and the mostly schistose rocks can be mylonitic: it comprises an eastern mafic-dominated sequence, a fault-bounded "Main Host Assemblage" (including the orebodies), and a metasediment-dominated western sequence.

The deposit lies within the Arthur Metamorphic Complex, an 8-km-wide, 110-km-long belt of high strain forming the dominant structural feature of northwestern Tasmania. The following structural events have been identified in the area (*most significant in mine area).

*Ca*D1	Cambrian deformation
*CaD2	Second Cambrian deformation (Tyennan Orogeny)
*Ca*D3	Third Cambrian deformation
*De*D1 to *De*D5	Devonian deformations (Tabberabberan Orogeny)

The part of the study discussed here aims to determine if any evidence of the regional structural and metamorphic history was preserved in the fabric of the ore. If so, could it provide evidence for the origin and timing of the orebodies? The study included outcrop mapping, samples from core and exposures, and 3D modelling of production data. New information was integrated with cross sections to produce more detail about lithological relationships.

Three-D models of magnetite percentage revealed its inhomogeneous distribution in North Lens, including several shallow, southerly plunging and pipe-like 'shoots.' Their geometry is suggestive of one to three distinct iron rich layers that were asymmetrically folded (isoclinal), attenuated, boudinaged, and sheared to form the pod-like swellings. 'Shoots' are surrounded by a carapace of serpentinitic mineralization encompassed by weakly mineralised, high-magnesium rocks.

A range of exquisite textures are preserved by the largely monomineralic magnetite ore, with an overprinting sequence recording the timing of magnetite formation relative to structural and metamorphic events spanning the CaD2 to Devonian events. Magnetite replaced a pre-CaD2 laminae (bedding?) that was also crenulated and overprinted by the regionally dominant CaS2 cleavage, along which new magnetite also formed. Subsequent CaS2-destructive, and apparently fluid-phase, magnetite-serpentine mineralization is probably late-CaD2. CaD3 produced a pervasive spaced cleavage. Late-stage, mostly brittle to brittle-ductile ore features are equated with Devonian events and include haematite and carbonate veins, localised asymmetric kink folds/thrusts, fibrous serpentine crack-seal veins, and brecciation of lens margins. The results support the view that the deposit formed during deep-seated metamorphism, from the skarnification of magnesium- and iron-enriched sediments.