Genesis of BIF-Hosted Martite-Goethite Ores: Concept and Application

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A new genetic model for supergene martite-goethite ore formation in the Hamersley Province of Western Australia provides a process understanding of how the ores formed that underpins successful extraction and allows us to maximise the value of our existing data sets. The model was developed using exploration drilling data, 2D geophysical data sets, 3D modelling, and ore petrography to understand controls on ore development from camp to grain scale.

Iron is leached from the BIF host rock, in the vadose zone, by meteoric-derived fluids that are reduced and acidic. Gravity drives the ore fluid downdip within the BIF and flow is focussed along bedding planes, which represent zones of enhanced permeability. The mineralisation takes place in three stages: i) replacement, ii) leaching, and iii) cementation. Further complexity is introduced by the fact that supergene ore formation can envelop a much older hypogene style of mineralisation and that both types of mineralisation are lateritised near surface.

There are several ways in which an ore-genetic understanding informs processes across the mining value chain. The ore-forming process modifies the mineral composition, texture, and porosity of the rock, which in turn influences its hardness and the material handling properties and lump to fines ratio of the mined product; it is thus a critical input to mine planning and scheduling. Increasing reliance on mathematical models and data analytics within geoscience requires an ore-genetic understanding to inform the selection of appropriate training data and/or application of appropriate domains. This is particularly important in the Hamersley context, where there are multiple ore-forming pathways (hypogene/supergene/weathering). Finally, some geoscience data sets are time consuming and costly to acquire. It is desirable to be able apply key learnings from operating mines to genetically similar deposits at an early stage of definition; here the concept of deposit analogues comes into play.