Spatial distribution of major, minor and trace elements in Pilbara Iron Ores, using micro-XRF technology

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ABSTRACT

There is increasing interest in minor and trace element levels in iron ore raw materials for ironmaking by steelmills. A number of minor and trace elements in iron ores can be concentrated in sinter plant and blast furnace dust streams, blast furnace slag, and in some cases present in the hot metal at the steelmaking stage. Steelmills are seeking continuous improvements in the reduction of these deleterious elements in process dust streams and especially in blast furnace slag and the hot metal.

Whilst the levels of many minor and trace elements are generally very low in iron ores from the Pilbara, less attention has been paid to documenting new orebodies beyond bulk RC drill chip assays and product specification data. Therefore, limited information is known about the spatial distribution of minor and trace elements at the hand specimen scale and elemental deportment within different ore and gangue minerals.

Utilising micro-XRF technology for spatial mapping and analysing banded iron formation (BIF), BIF-hosted bedded iron deposit (BID) and channel iron deposit (CID) samples has shown distinctive minor and trace element distributions. The mapping of deleterious elements (e.g., Zn, As, Cu) has enabled the deportment and abundance within the ore and gangue minerals to be assessed. Additionally, mineral identification using SEM based systems has recognised kaolinite, gibbsite, k-feldspar, barite, cryptomelane and carbonates, providing the ability to recognize weathering, supergene leaching and original depositional textures within these samples. The BID samples show distinct patterns of trace element distribution in microbands that are believed to reflect the original BIF host. The microplaty hematite sample shows an enrichment of light rare elements compared to supergene enriched martite-goethite BID ores. The CID samples show the concentric layering of the cemented pisoids and ooids and leaching of the gangue minerals, through the residual enrichment of incompatible minor elements.