Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31136

Insight into the genetic complexity of magnetitite layers of the Bushveld Complex by continuous mesoscale scanning.

DIETER RAMMLMAIR[1], WILHELM NIKONOW[2], JEANNET A. MEIMA[2], DACHUAN WANG[1], FRANÇOIS HOLTZ[1] AND MALTE JUNGE[3]

[1]Leibniz University Hannover
[2]Federal Institute for Geosciences and Natural Resources (BGR)
[3]Natural History Museum Bern

Magnetitite layers in the Marula drill core BH7772 from the Upper Zone, Eastern Lobe, Bushveld Complex, donated by Impala Platinum to the ICDP-BVDP project, were investigated in detail. Based on the continuous scanning of core sections of Layer 21 (212.08 to 223.82 m sampling depth) and Layer 17 (248.46 - 248.83 m) using Energy dispersive x-ray fluorescence scanning (µEDXRF) at 40 µm to 20 µm resolution in combination with automated mineralogy classification, unexpected complex textural features and mineral chemical pattern could be extracted. Laser Induced Breakdown Spectroscopy (LIBS) and HyperSpectral Imaging with Long Wave InfraRed complemented chemical and textural analysis.

Continuous scanning of Layer 21 showing flow textures due to preferential orientation of ilmenite grains and dragged silicate minerals and layer fragments indicates a downward movement of an Fe-rich melt. Magnetite is crosscutting preexisting lithologies represented by gabbro-norite and anorthosites showing boudin structures. This interaction of Fe-rich melt, fluids and rock fragments generated at this boundary is expressed by symplectite boundary layers and trapped pegmatoidal melt pockets. These textures are interpreted to be formed by the separation of immiscible Fe-rich melt and hydrous silicate melt and expelled by flow separation. This observation is supported by polished thin section microscopy, SEM-EDX mapping and EPMA analyses. Three distinct compositional ranges for Mg# and An# are observed for mafic phases such as olivine, amphibole, biotite, pyroxenes, and plagioclase respectively. Primocrysts from preexisting rock and layer fragments show lowest values, pegmatoidal pockets intermediate and symplectites the highest values with gradual changes.

Within the magnetite variable chemical gradients for Ti, Mg, Al, Mn, Cr and V are observed, which vary from layer to layer. One of the most interesting aspects is the elevated Cr content due to assimilation of chromite and Cr-rich clinopyroxene from some of the preexisting partially digested anorthosites and gabbro norite with relic chromites. Locally Cr-enriched magnetite is transported downwards.

Detailed investigation of Fe isotopes from by fs LA-ICP-MC-HR-MS confirms the complex processes related to the formation of magnetite layers.

We demonstrate that a continuous high spatial resolution scanning of large area is the key to identify and interpret such complex textures.