The Deeper Platreef at Sandsloot: New Insights Into Controls on Ni-Cu-PGE Mineralisation in the Bushveld Complex

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Platinum group elements (PGEs) are vital components in internal combustion engines and hydrogen fuel cells and play an increasingly important role in battery technology. The northern limb of the Bushveld Complex, South Africa, is widely regarded as one of the world's largest resources of PGEs. Brown-field exploration at sites within the northern limb, such as downdip of Sandsloot, offers exciting new targets for PGEs, whilst further illustrating the complexities present within the Bushveld Complex.

Within the northern limb, the Platreef forms the major PGE-Ni-Cu-Co deposit and is part of a complex package of Critical Zone (CZ) rocks differing from the wider Bushveld in that high-grade PGE mineralization is spread over much greater thicknesses compared to the Merensky Reef. Additionally, it lies north of the Thabazimbi-Murchison lineament and rests directly on the metasedimentary Transvaal Supergroup and accompanying footwall structures. Therefore, footwall interaction is likely to have had a significant impact on the emplacement and magmatic pathways of the northern limb magmas, as well as their contamination histories and resultant stratigraphy.

In this study, the petrology and bulk geochemistry, including Nd-Sr-Hf-Pb isotopic compositions, of samples from Sandsloot are examined, with the aim of establishing the primary magmatic stratigraphy of the newly discovered deep Platreef, downdip of the Sandsloot open pit. The Platreef is thought to have formed from discrete magmatic units, and several, including a barren zone, PGE-reef, and base metal zone, are identified at Sandsloot. Varying CaO/Al_2O_3 and Eu/Eu* ratios, as well as Pb and Sr anomalies and the presence of enigmatic hybrid textures, are interpreted to represent local dolomite contamination and hydrothermal alteration of the magmatic units. Thickness variations are proposed to be related to the changing topography of the underlying footwall architecture, and magmatic erosion during intrusion of Main Zone magmas post-Platreef emplacement.