

Chromite and Sulphide Mineralization of the Uitloop Ultramafic Bodies in the Northern Limb of the Bushveld Complex, South Africa

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The Uitloop farm, located in the northern limb of the Bushveld Complex, represents a geologically complex and understudied region. Historically, the area was described as hosting two Lower Zone (LZ) offshoots; Uitloop I and II, intruded into the Archaean basement and Transvaal Supergroup. However, recent deep drilling has revealed presence of a Platreef offshoot as well as Marginal Zone sills.

Differentiating the LZ from the Platreef Unit is challenging due to overlapping mafic/ultramafic lithologies, chromite, and abundant sulphide mineralization. However, distinct mineral chemical signatures (olivine, chromite, and pyroxene) and whole-rock geochemical trends enabled stratigraphic discrimination. Correlations with adjacent Turfspruit and Macalacaskop regions confirmed alignment of the Uitloop Platreef offshoot with the main Platreef Unit, even though it lacks the Main Zone hanging wall and is instead commonly enveloped by Duitschland Formation metasediments. Mineralization in the Uitloop Platreef offshoot exhibits classic 'Platreef-style' patterns; (i) contact-style mineralization, marked by elevated Ni-Cu and PGE concentrations in sulphide-rich magmatic sequences and footwall rocks, and (ii) reef-style stratabound mineralization associated with chromitite seams in the upper magmatic sequences.

Sulphur isotope analyses of Uitloop sulphides revealed assimilation of ca. 2.4 Ga marine sulphate evaporites from the Duitschland Formation. Thus, we suggest that during and after the Great Oxygenation Episode, sulphate evaporites became an important S source to the mafic/ultramafic magmatic systems, facilitating formation of world-class Ni-Cu-PGE mineralization.

The global demand for Ni and Cu surged, driven by the rapid adoption of renewable energy technologies because of stricter emissions regulations aimed at decarbonizing economies. While demand for PGMs, traditionally dominated by the automotive industry, has declined amid the shift toward battery electric vehicles, emerging technologies such as hydrogen fuel cells and green hydrogen production are poised to revitalize PGE markets. Detailed investigations of poorly understood magmatic sulphide intrusions are essential to secure future metal supplies.