

Multi-Method Comparison of Mineral Abundance Estimates for the Sandsloot PGE-Ni-Cu Deposit, Platreef, Northern Bushveld Complex

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The Platreef is the main host of PGE-Ni-Cu mineralisation in the Northern Limb of the Bushveld Complex, South Africa. The Sandsloot deposit, part of Anglo Platinum's Mogalakwena operation, is typified by pyroxenites separated by metasediment intervals from footwall dolomites of the Transvaal Supergroup. To develop the recently explored underground resources, mineralogical characterisation is essential but is challenging to accomplish in complex deposits like Sandsloot.

We conducted a comparative study across 19 drillholes of quantified mineralogy generated from fusion X-ray fluorescence (XRF), assay whole-rock geochemistry, quantitative X-ray diffraction (QXRD), bulk mineralogy analysis (BMA), Fourier Transform Infrared (FTIR) spectroscopy, and shortwave infrared-visible near infrared (SWIR-VNIR) hyperspectral data. Initially, data were integrated across different spatial scales, via a weighted mean value over 1-meter segments of core for the geochemical and vibrational spectroscopy datasets that corresponded with the 5-meter sampling intervals used for QXRD and BMA analyses. A preliminary calculated mineralogy model was produced from the whole rock data using a linear programming method. In total, 132 samples were compared against QXRD results and regression analysis was applied to assess model performance.

Each mineralogy estimation method identified a distinct range of minerals reflecting the limitations of each technique, particularly in vibrational spectroscopy, where minerals exhibit different responses across various wavelengths. Based on correlations between estimates of the main mineral phases: FTIR demonstrates good correlation ($R^2 = 0.71-0.94$) with traditional mineralogical analysis but lacks a model for olivine; calculate mineralogy performs well for abundant phases (e.g., orthopyroxene, clinopyroxene, plagioclase and serpentine) but poorly for olivine, chlorite and other alteration minerals; hyperspectral imaging lacks reliable matching for specific minerals, particularly clinopyroxene and olivine. Therefore, no single technique can accurately predict all mineral phases. A combination of methods may yield better results by incorporating mineral chemistry into calculations and refining spectral features.