The Mineralogy and Mineral Associations of Platinum-Group Elements and Base Metal Sulfides in the Down-Dip Critical Zone at Sandsloot, Northern Bushveld Complex

Kate R. Canham[1], David Holwell[1], Iain McDonald[2], Hannah Hughes[3], Andy Lloyd[4], Lara Du Preez[4], Kofi Acheampong[4]
1. Centre for Sustainable Resource Extraction, University of Leicester, Leicester, United Kingdom, 2. School of Earth and Environmental Sciences, Cardiff University, Cardiff, United Kingdom, 3. Camborne School of Mines, University of Exeter, Exeter, United Kingdom, 4. Anglo American South Africa, Johannesburg, South Africa

The extraction of new resources of PGEs, Cu, Ni, and Co is critical to satisfy increased demand driven by the energy transition. Developing genetic models for ore deposits aids in the generation of exploration targets, whilst understanding the geometallurgy of individual deposits is paramount to efficient processing of ores. The Northern Limb of the Bushveld Complex is renowned as one of the Earth's largest resources of PGEs and also contains important resources of Cu, Ni, and Co. The Critical Zone of the limb hosts the world-class Platreef PGE-Ni-Cu-(Co) deposit, which thickens and increases in grade down-dip, reaching >10 g/t (4E) over tens of meters. In the Sandsloot area of the Northern Limb, recent exploration of the down-dip Critical Zone has identified multiple high-grade PGE-rich zones, as well as thick base metal sulfide (BMS)-rich zones up to several hundred meters below. To date, these down-dip zones at Sandsloot have received no detailed mineralogical study.

The upper PGE-rich zone has around 1 to 2 vol % sulfides, with a typical assemblage of pyrrhotite-pentlandite-chalcopyrite, with lesser cubanite. The most common platinum-group minerals (PGMs) are Pt-Fe alloys, Pt-Pd-Pb alloys, and Pt-Pd bismuthotellurides. In contrast, the lower BMS-rich zone contains lower-tenor semi-massive to massive sulfides, composed dominantly of pyrrhotite, with lesser pentlandite and minor chalcopyrite. Relative to the PGE-rich zone, this zone contains much lower PGE grades, and notably an IPGE-dominant PGM assemblage of Ir arsenides, Ir-(Pt,Rh,Rh) arsenosulfides, and Ru sulfides (62%), with lesser Pt arsenides (18%), Pt-Pd bismuthotellurides (9%), and Pd-Pb alloys (4%).

In this ongoing study, we integrate PGM and BMS variation throughout these zones, with lithological and alteration styles established from hyperspectral and mineralogical analysis. This will establish how magmatic, contamination, and hydrothermal processes have affected the geometallurgy and metal budget of each zone.