Contribution ID: **27** Type: **not specified**

The use of chemostratigraphy and geochemical vectoring as an exploration tool for platinum group metals in the Platreef, Bushveld Igneous Complex, South Africa: A case study on the Sandsloot and Overysel farms

Thursday, 2 October 2014 09:45 (15 minutes)

The paucity of geochemical criteria for stratigraphic correlations and defining the styles of mineralisation pose serious problems in locating PGE-rich zones in the Platreef. This study is therefore aimed at identifying and appraising process-based mineralogical/ geochemical criteria which may be useful in stratigraphic correlations and characterizing the nature and styles of PGE mineralisation. In addition, the work investigated the possible use of geochemical vectoring as a tool to locate the PGE-rich zones. Boreholes OY 482 and SS 330, drilled at the Overysel and Sandsloot farms respectively, were logged, and a total of 119 quarter cores were sampled for petrographic studies. The elemental contents in the rocks were determined by XRF and ICP-OES analyses and were evaluated using various statistical and mass balance techniques.

In borehole OY 482, where the floor rock is Archaean granite, the Platreef consists of three feldspathic pyroxenite sills referred to as Lower, Middle and Upper Platreef units, from the bottom to the top, respectively. The results show that the Lower and Upper Platreef units have higher median values of Mg# (0.58 and 0.57) and Ni/Cu (0.68 and 0.75) when compared to the Middle Platreef (Mg#: 0.54 and Ni/Cu: 0.67) which may not be totally suggestive of two magmatic intrusive pulses. In borehole SS 330, where the floor rock is dolomite, the rocks consist of clinopyroxenites and olivine clinopyroxenites (variably serpentinised). These two units are intercalated with each other and are products resulting from the injection of Platreef magma sills within the dolomite floor rock.

The hierarchical clustering and mass balance calculations show that when compared to the Platreef feldspathic pyroxenites, which have higher SiO2, Al2O3 and Fe2O3 median contents, the clinopyroxenites possess higher CaO median content whereas the olivine clinopyroxenites have higher MgO and LOI median contents. The PGE-rich zones (i.e. Pt+Pd) in clinopyroxenites are marked by low Ca/Mg median values, whereas in both, the olivine clinopyroxenites and the Platreef units, these zones are marked by high Mg/Fe median values.

The suggested base metal index [(Cu/Zn) x (Ni/Co)] used to vector towards PGE-rich zones, which reflects the presence of the base metal sulphides (BMS), correlates with the Pt+Pd in the BMS-rich zones. This is not always the case in zones of low BMS contents which may reflect changes in the mineralogy of the BMS.

In conclusion, the two boreholes studied show contrasting petrographic and geochemical attributes. This dissimilarity is mainly due to the fact that borehole OY 482 comprises Platreef magmatic rocks whereas borehole SS 330 intersected metamorphic/ metasomatic rocks.

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Session Classification: Minerals

Track Classification: Oral and Poster Presentation