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Platinum mining in western Bushveld - A relation between primary mineral alteration and loss of recovery in PGEs

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The Pilanesberg Platinum Mine (PPM) is an opencast project situated north of the Pilanesberg Alkaline Complex (PAC) on the southern border of the Swartklip facies of the western limb of the Bushveld Igneous Complex (BIC) in the North West Province, South Africa. Operations focus on the extraction of platinum group elements (PGE) from normal and potholed Merensky and pseudo reef, as well as the upper group 2 chromite (UG2) reef in the lower critical zone of the BIC [1]. PGE recoveries from the ore bodies are poor and erratic.

Various intrusive bodies such of the Pilanesberg Alkaline Complex and associated dykes and sills are located in close proximity to the mine, as well as iron-rich ultramafic pegmatites that intersect portions of the reef [2]. Fluids generated from these intrusions, amongst others, resulted in the alteration of the primary minerals orthopyroxene, olivine and plagioclase. The alteration products are inferred to be the cause of the unexpected low recoveries, thus the aims are to 1) identify the alteration or secondary minerals associated with the ore/reef, 2) as well as determining the location of the ore minerals in relation to deformational features and alteration veins running through the rocks.

To determine the association between primary, secondary/alteration, and ore minerals thin sections from three borehole sections were investigated using a petrographical microscope. Offcuts from the thin sections were scanned at NECSA's MIXRAD facility to obtain 3-dimentional images of the location of the PGE-bearing grains in relation to alteration veins. Twenty four pulverised run of mine samples were collected from three mining blocks in the open pit and analysed by x-ray fluorescence spectrometry (XRF) and x-ray diffractometry (XRD).

The analytical results (mineralogical and chemical) show that extensive alteration occurred and the primary minerals were altered to secondary products. Olivine to a large extent and orthopyroxene to a lesser extent have been altered to serpentine (lizardite) and talc. Other alteration products include chlorite, biotite, and biotite amphibole. Very fine-grained opaque minerals in the range of one µm occur as discrete specks in the serpentine. Correlation matrices of whole rock major elements depict a positive relationship between Al and Ca, and a negative relationship between Mg and Ca, and Mg and Al. another observation is the decrease in Si concentration as the concentration of Mg-rich alteration minerals increase. The conclusion is made that there is a strong possibility that poor PGE recovery is due to trapping of PGM's by the alteration products of primary minerals.

References:

[1] Barnes, S. & Maier, W.D. 2002. The Geology, Geochemistry, Mineralogy and Mineral Beneficiation of Platinum-Group Elements. Volume 54:431-58
[2] Reid, D.L. and Basson, I.J. 2002. *Mineralogical Magazine. Vol. 66(6): 895–914*