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Mineralogy of the Merensky Reef cyclic unit at Two Rivers Platinum Mine, Eastern Bushveld Complex, South Africa

J.J. Beukes (1), C.D.K. Gauert (1), E. Kotzé (1), and J. Coetzee (2)

(1) Dept. of Geology, University of the Free State, Bloemfontein, South Africa (jj_lishus@yahoo.com), (2) Two Rivers Platinum Mine, Dwars River-Steelpoort, South Africa (juan.coetzee@trp.co.za)

The Two Rivers Platinum Mine, located in the southern sector of the eastern limb of the Bushveld Igneous Complex, extracts PGEs from the UG-2 chromitite and Merensky Reef units. To assist in the investigation of the various Merensky Reef facies types from a condensed to a more expanded reef, exact mineralogical and geochemical characterization was carried out.

Sixty-two polished thin sections of 48 samples from an upper Critical Zone drill core intersection of the southern license area revealed (in decreasing order) mesocumulates of orthopyroxene, plagioclase, clinopyroxene and chromite, with biotite, sericite and base metal sulphide minerals as (inter-)cumulus phases, both at variable modal proportions.

Cryptic mineral variations such as an decrease of the chrome number in chromites as well as an increase of Ti and Mn concentrations of orthopyroxene can be observed within the investigated interval from the footwall of the Merensky Reef to the top of the Bastard Reef. The enstatite content of orthopyroxene however clearly decreases with increasing stratigraphic height. This enstatite variation probably indicates fractional crystallization from a more primitive liquid and subsequent settling of those crystals.

With regards to geochemistry, the Mg number of whole rock samples decreases with increasing stratigraphic height, mimicking the transition into plagioclase dominated cumulates. Trace element ratios such as Ti/Zr and Cr/V are relatively constant but abruptly increase towards the bottom of the stratigraphic profile. Such ‘jumps’ of Cr/V and Ti/Zr ratios above the UG-2 chromitite layer possibly indicate evolved magma replenishment in the upper part mingling with more primitive resident magma in the lower part of the stratigraphic column. Strong Sr isotopic variations at the same stratigraphic level found by Kruger and Marsh (1982) indicate the mixing of magmas of different origin.

Significant PGE concentration (more than 10ppm in total) is associated with the chromitite stringers of the Merensky Reef in this borehole, whereas throughout the sulphide-bearing Merensky pyroxenite PGEs occur erratically with a maximum content of more than 25ppm. Among the PGEs, elements of the Pt-subgroup (Pt, Pd and Rh) are most abundant in the Merensky Cyclic Unit (MCU). PGE patterns of a third of such samples show enrichment of Rh, Pt, Pd and Au normalised to both chondrite and solar abundance values; however, most samples are depleted in Os, Ir, Ru and Au compared to chondrite. Findings indicate that the formation of chromite was just as important for concentration of PGEs in the MCU as was the process of sulphide scavenging.

Reference

Kruger, F.J., and Marsh, J.S. (1982). The significance of $^{87}Sr/^{86}Sr$ ratios in the Merensky cyclic unit of the Bushveld Complex. Nature, 298: 53-55.