Trace Element Distribution Patterns in Pyroxene of the UG2 Unit Crystal Mushes, Bushveld Complex

M. BRODBECK[1]*, B. S. KAMBER[1], I. KLEINHANNS[2], R. SCHOENBERG[2]

[1]Department of Geology, Museum Building, Trinity College Dublin, Dublin 2, Ireland (*correspondence: maurice.brodbeck@icrag-centre.org)

[2]Department of Geosciences, University of Tübingen, Germany

The UG2 chromitite is a world-class PGE and Cr deposit hosted in the mafic layered series of the Bushveld Complex (BC) in South Africa. Despite substantial research efforts during the last decades the magmatic processes that led to the mineralisation of the UG2 have remained controversial.

In the studied drill core (BH8039) from the eastern limb of the BC, the UG2 chromitite occurs as two distinct seams that are associated with noritic to melanoritic rocks, representing pyroxene rich cumulates. Orthopyroxene (opx) is a ubiquituous phase in this sequence, called the UG2 unit.

The enormous volume of the BC $>10^6 km^3$ and emplacement temperatures of 1200-1300° [1] entail a prolonged cooling period. This explains why most crystals in the mush show limited to no major element zonation, which was obliterated by diffusion.

Here we present a study that applied LA-ICP-MS mapping to opx in an attempt to test whether this mineral might record trace chemical information about chromitite formation.

The maps reveal zonations in certain trace elements, e.g. in Cr. Because distinct zones were identified within the minerals, quantitative data were extracted from areas of relative homogeneity using a novel data analysis tool [2]. ‘Core’ and ‘rim’ zones in opx differ significantly in Cr concentration. The most striking finding is that the ratio of the Cr ‘core’/’rim’ area size changes over the stratigraphic interval of the UG2 and that opx ‘rim’ areas are most extensively developed in UG2 subunits associated with the upper chromitite seam and above.

We interpret this pattern to reflect that opx in these subunits is directly influenced by formation of chromite, causing intense depletion in Cr in the residual liquid. This also suggests that opx and chromite formed from the same liquid. In subunits associated with the lower chromitite, opx ‘rims’ are relatively narrow, suggesting that there, crystallisation of the two phases may not be related. We therefore conclude that the two chromitites may have formed via two different processes.

[1] Cawthorn & Walraven (1998), Journal of Petrology **36**, 1669-1687. [2] Petrus & Kamber (under revision) Chemcial Geology