

Geological constraints on the origin of the UG2 chromitite of the Bushveld Complex, South Africa

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The UG2 chromitite of the Bushveld Complex has been variously interpreted as resulting from: magma mixing followed by gravitational settling of chromite to the magma chamber floor; a pressure-induced burst of crystallization of chromite; the emplacement of chromite-rich slurries from a staging chamber and hydrodynamic sorting of a mobilized slurry containing disseminated chromite. To test these models, we present field observations of the UG2 chromitite in potholes, roughly circular depressions in which some of the footwall rocks are absent. The most telling observations are: (a) extensive magmatic erosion of the footwall to the UG2; (b) extensive magmatic erosion of cumulate rocks within the UG2 itself; (c) nearly solid rocks a few meters below the footwall prior to crystallization of the UG2; (d) igneous layering concordant with inclined sidewalls of potholes; (e) chromitite layers of the UG2 developed along subvertical sidewalls of potholes. None of the existing models for the origin of the UG2 are entirely consistent with these observations. We propose an alternative hypothesis that involves the following sequence of events: (1) new dense magma mixed with the resident melt as it entered the chamber and the resultant hybrids then spread out laterally along the floor as basal flows; (2) as a consequence of mixing, the hybrid magmas were initially superheated and caused intense thermochemical erosion of the footwall cumulates, resulting in an igneous unconformity; (3) on cooling of the hybrid magma, chromite and sulphides formed *in situ* draping the irregular erosional surface; (4) chromite and sulphides effectively scavenged PGE from magma that was continuously delivered to the base of the chamber during vigorous thermal/compositional convection. Multiple pulses of emplacement lead to repetition of this sequence of events, resulting in the UG2 chromitite layer. *In situ* crystallization of basal layers of chromite-saturated magma may be a viable interpretation of PGE-rich chromitites in other layered mafic-ultramafic intrusions.