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Field observations bearing on the origin of UG1/UG2 chromitites in the Bushveld Complex

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The origin of chromitites in the Bushveld Complex has been interpreted in three principal ways: (1) gravity-controlled settling of chromite onto the chamber floor from magma that was saturated in chromite, either initially or due to an internal process (e.g. magma mixing, crustal contamination, increase in oxygen fugacity or lithostatic pressure); (2) gravity-controlled settling of chromite from slurries containing crystals of olivine, orthopyroxene and chromite brought into the chamber from a deeper magma reservoir; (3) gravity- and size-controlled separation of chromite from co-existing olivine and orthopyroxene crystals within semi-consolidated cumulates undergoing late-stage slumping. Here we present field observations from potholes beneath the UG1 and UG2 chromitites, crudely circular structures in which footwall rocks were removed by magmatic erosion, that rule out all three hypotheses. A key observation is that chromitites drape the irregular margins of potholes even where they are vertical or overhanging. These relationships eliminate both early settling of chromite from overlying magma and late mechanical segregation of chromite within cumulates as viable hypotheses. In addition, thick chromitites commonly consist of several texturally and compositionally distinct sublayers locally separated by thin partings of orthopyroxenite or anorthosite. The absence of thick sequences of intervening silicate rocks from which chromite may have been separated to form these sublayers refutes an origin from crystal slurries. Similarly, pothole margins that cut chromitites in the footwall cumulates and the indentation of chromitite layers beneath angular to sub-rounded autoliths are not consistent with any late-stage origin of chromitites within a cumulate pile. The field relationships appear to be compatible only with the emplacement of superheated, dense magma along the temporary base of the chamber during episodes of replenishment that led to intense and prolonged melting and dissolution of the pre-existing cumulates, followed by the *in situ* crystallization of chromite directly on the irregular chamber floor. Chromitites of different thickness were produced, depending on the volume of the replenishments. We suggest that *in situ* crystallization of basal layers of magmas that are saturated with chromite on emplacement into the chamber is an elegantly simple and straightforward explanation for the origin of chromitites in layered intrusions.