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Bushveld's base has foundered

Arndt N¹, Wilson, A²., Roman, A³, Jaupart, C³

¹ ISTerre, University Grenoble Alpes Nicholas.arndt@ujf-grenoble.fr

² University of the Witwatersrand, Johannesburg, South Africa

³ IGP, Paris, France

The Bushveld Complex in South Africa is the world's biggest mafic-ultramafic intrusion and one of the richest repositories of magmatic ores. Despite decades of study, many aspects of the emplacement of the intrusion continue to pose problems. Foremost are mismatches between the volume of magma required to account for the major deposits of Cr and platinum-group elements and the volume of mafic rock preserved in the complex. A large volume of magma is missing, but the most obvious explanation - that the missing magma erupted - is contradicted by the small volumes of mafic lava at the surface. The recent discovery of highly magnesian rocks at the periphery of the complex exacerbates the situation because these would have produced large volumes of ultramafic cumulates. Geophysical data are also problematic. The centre of the complex, where a large mass of dense rock should be present if the intrusion had the funnel shape that is normal for large mafic-ultramafic intrusions, displays negative gravity anomalies. A solution is offered by recent analogue and numerical modelling of the emplacement of mafic magma into crustal magma chambers. This modelling shows that the dense lower mafic-ultramafic cumulates of an intrusion with the form, size and geological context of the Bushveld Complex would founder and descend deeper in the crust. We propose that the complex as currently exposed at the surface represents only a small portion of an initially much larger intrusion.

