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Processes and Ore Deposits of Ultramafic-Mafic Magmas through Space and Time

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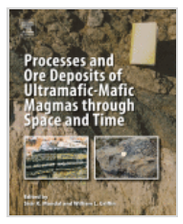

Chapter 4 – Mixing and Unmixing in the Bushveld Complex Magma Chamber

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Abstract

The Rustenberg Layered Suite (RLS) of the Bushveld Complex (hereafter referred to as simply “the Bushveld Complex”) is an >8 km thick layered ultramafic-mafic magmatic deposit located in South Africa. The Bushveld Complex contains over 80% of the world’s PGE reserves as well as numerous Fe-Ti-V mining operations. As such, the Bushveld Complex has received a significant amount of attention from economic geologists and petrologists alike. PGEs in the Bushveld Complex are concentrated into two primary layers, the “Merensky Reef” and the “UG2 Chromitite” layer. Several theories about the formation of these layers and the concentration of PGE within them have been proposed; many of them involve the input of new magma and progressive magma mixing within the chamber. In addition, the upper portions of the RLS are actively mined for Fe-Ti-V concentrated in magnetitite layers. Several theories for the formation of the magnetitite layers exist, which include new pulses of magma mixing or progressive unmixing in the form of silicate liquid immiscibility. This study reviews the evidence for magma mixing at various levels within the magma chamber and the physical and chemical consequences of new magma input. In addition, new research in the last 5 years has shown that significant Fe-Ti deposits can be generated during magma *unmixing*, due to large-scale immiscibility of silicate liquids in highly evolved magmas. A review of the physical and chemical signatures of immiscibility and magma unmixing in the Bushveld Complex is also included here.

Keywords

Magma mixing; recharge; bushveld complex; liquid immiscibility