



The top of the Bushveld Complex, South Africa

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A mass balance calculation for incompatible elements from the upper part of the Bushveld Complex indicates that some evolved rocks are missing from the observed stratigraphy. Previous attempts to model the evolving liquid and mineral compositions of the Upper Zone are based on two challengeable assumptions: that the crystallization surface was exactly parallel to the roof, and that the Bushveld Granite was emplaced exactly at the top contact between Upper Zone and roof rocks (Rooiberg Felsites). Both assumptions can be shown to be incorrect. An area has been found where more evolved rocks than previously identified occur beneath the Rooiberg Felsites, and demonstrate that this evolved magma migrated laterally, not vertically, as suggested in previous models. These observations show that vertical summation of the compositions in the intrusion cannot give the correct answer for the composition of the magma. Previous sections through the Upper Zone indicate quite melanocratic and oxide-rich rocks at the top. In contrast, the evolved rocks described here contain up to 20% of both quartz and hornblende. Alteration by deuteritic fluids has made quantitative distinction of alkali feldspar and plagioclase progressively more difficult upward, but a considerable proportion of the former is present. Very minor olivine, clinopyroxene and oxide phase are present. They can be called hornblende granodiorites. These rocks no longer display a demonstrably cumulus texture, although one example of phase layering has been found, and so it is questionable whether the chemistry of these rocks should be treated as cumulates or essentially liquids. Close to this uppermost contact there are inclusions of felsites, but they are distinctly finer-grained and so readily distinguishable in the field, although their chemical compositions are not very different from the granodiorites. It is possible that some mixing between the residual magma and remelted roof rocks occurred, which further complicates what the compositions of these rocks indicate with respect to the final differentiated magma of the Bushveld Complex. To emphasize that the rocks described here are distinctly different from all other Upper Zone rocks, it is proposed that they be called the Residual Zone of the Bushveld Complex.