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Thermodynamic examination into the causation of the mineralogical cyclicity of the Upper Zone of the Bushveld Complex.

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The Upper Zone represents the topmost section of the Rustenburg Layered Suite (RLS). The stratigraphy of the Upper Zone includes a number of anorthosite layers but is better known due to the presence of thick magnetitite layers which host large concentrations of vanadium. What makes the Upper Zone interesting on a petrographic level is the presence of a number of mineralogical and geochemistry "cycles" which appear to coincide with the anorthosite and magnetitite layers.

The lithology of the Upper Zone is the most evolved of the RLS. The anorthosite becomes increasingly more albitic and the olivine and pyroxene compositions become increasingly more felsic. However, the geochemical evolution is punctuated by a number of geochemical reversals. The cycles of the Upper Zone are best illustrated by the An% of the plagioclase compositions [Ca/(Ca+Na+K)] and the Mg# of the olivine and pyroxene [Mg/(Mg+Fe)] with nine visible cycles (I-IX). The presence of these cycles was first published by Tegner *et al.* (2006)[1] and further studied in Britt (2014)[2].

Geochemical reversals are most easily interpreted as additional magma pulses which reset the An% and Mg# to less evolved compositions. However, due to the $^{87}Sr/^{86}Sr$ data published by Kruger *et al.* (1987) [3] and Tegner *et al.* (2006) (and all authors therein), the uppermost portion of the RLS is said to have crystallised from a single batch of magma. Therefore, the model responsible for the formation of the magnetitite and anorthosite layers and consequently the geochemical cycles would require a closed system. Models such as pressure fluctuations [4] and double diffusive convection [1] are the most commonly accepted models with some authors, such as Scoon & Mitchell (2012) [5] still maintaining the possibility of an open system.

The purpose of this study is to use dihedral angles to determine the thermodynamic evolution of the solid-fluid interface as the Upper Zone crystallised. Using the techniques described in Holness (2005) [6] the changes in the dihedral angle will provide newfound insight into the formation of the Upper Zone. The resulting data could either provide substantial support to the existing models or result in the development of a new, more precise model.

References:

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