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Evolution of the Marginal and Lower Zones of the Eastern Bushveld Complex: implications for early magma chamber processes

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The relationship between the Marginal Zone and the entire Bushveld Complex, the emplacement and differentiation of the magmas involved at the earliest stages of the intrusion are still issues of discourse. The Marginal Zone norites have been associated with the earliest intrusion of basic magma and thus the parental magma(s) of the Rustenburg Layered Suite. Poor exposures and incomplete section exposures have limited previous studies regarding the earliest stages of the Bushveld Complex. The main debate has been whether the Marginal rocks are representative of some parental magma composition of the earliest phases of the intrusion. This work presents results from a study of borehole CH6 that intersects the contact between the Marginal and Lower Zones in the Clapham Trough, Eastern Bushveld Complex.
CH6 shows that the Marginal Zone rocks become progressively enriched with plagioclase with increasing height, coupled with increasing whole-rock and plagioclase An#. Contrastingly, the whole-rocks and orthopyroxene Mg# decrease. On the other hand, the orthopyroxene-rich Lower Zone shows gradually increasing Mg# with height. Therefore, these relations indicate reversal(s) to more primitive magma compositions, as supported by geochemical modelling indicating liquids with about 5.37 and 9.96 wt. % MgO for the Marginal and Lower Zones were involved, respectively. The different major and trace element trends also suggest that the two zones did not form from the same liquid. Moreover, the data show that both zones were formed through processes involving differentiation. The Lower Zone, however, reflects fractional crystallization from a more primitive magma with contemporaneous injection of new magma. This study suggests lower MgO content for the Lower Zone magma(s) than suggested in previous studies and was produced by mixing of primitive B1-magma with the evolved Marginal Zone residual liquid. This conjecture is supported by the absence of a chill at the contact of the two rock units and an abrupt change in compositions across the boundary.