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Trace element and Sr-isotopic variations in plagioclase of the Main and Upper zones, Northern and Western limbs, Bushveld Complex.

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Many studies on the Bushveld Complex [1-4] and other layered intrusions [5,6] have shown the existence of isotopic disequilibrium, both between and within particular (cumulus) minerals, with a wide variety of processes having been proposed to explain this phenomenon. For the Bushveld Complex, these processes include the blending of semi-consolidated crystal mushes during subsidence, the density driven mixing of minerals from isotopically distinct magma pulses, the infiltration of isotopically distinct contaminants and the intrusion of variably contaminated crystal mushes from deeper crustal staging chambers.

Here we compare the results of two detailed in-situ (LA-ICP-MS) Sr-isotopic and trace element investigations conducted on plagioclase from the Main and Upper zones of the Bushveld Complex as intersected by the Bellevue [7] and Moordkopje [3] drill cores on the Northern Limb of the Bushveld Complex and by the Bierkraal 2 [8] drill core on the Western Limb of the Bushveld Complex, respectively.

In the Northern Limb, the lower part of the Main Zone displays highly variable initial Sr-isotopic ratios, coupled with near constant plagioclase An%. Lower and less variable initial Sr-isotopic values are recorded for the Main Zone above the troctolite layer and for the Upper Zone, which is coincident with a “normal” differentiation trend as exemplified by plagioclase An% [9]. We interpret the results for the Northern Limb as being the product of i) the repeated intrusion of variably contaminated crystal mushes from a deeper staging chamber that gave rise to the lower parts of the Main Zone; ii) a “final” voluminous influx of magma from a deeper staging chamber that underwent fractionation within the presently exposed parts of the Bushveld Complex, that gave rise to the upper Main and Upper zones. A broadly similar sequence of events may have been operational over the same stratigraphic interval in the Western Limb of the complex.

References:

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