

Petrographic and Field Evidence for Low-Pressure Magmatic Dolomite Crystallisation at the Bulhoek Complex, South Africa.

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The Proterozoic Bulhoek Complex consists of three centres of intrusion of magnesian carbonatite over a total strike length of some 25km: the main Bulhoekkop intrusive centre; Bulhoek South and Welgevonden to the south. At each of these centres sheets of magnesian carbonatite intrude into, and metasomatise, granites and granophyres of the Bushveld Complex. No magmatic alkaline silicate rocks are found at any of the intrusive centres.

Emplacement occurred in pulses and three phases of carbonatite are recognisable: phase (I) characterised by an abundance of granitic country rock clasts; (II) a porphyritic carbonatite; and (III) late veinlets of very fine-grained carbonatite. Primary igneous textures preserved in the phase III dykes include tabular, flow-aligned, single grains of dolomite. The carbonate in all three types is ferroan dolomite [$0.0 < \text{Fe}/(\text{Fe}+\text{Mg}) < 0.25$] to ankerite [$\text{Fe}/(\text{Fe}+\text{Mg})$ of 0.25-0.55]. Phenocrysts in phase II carbonatites are typically ferroan dolomite but rarely, particularly in the Bulhoek South centre, corroded phenocrysts of calcite are recognised. Accessory phases are magnetite and apatite. The carbonatites have high Mg#s ranging from 72 to 88 (mean 81).

Regional stratigraphic constraints show that these carbonatites crystallised at depths of no more than $500 \pm 250\text{m}$ i.e. at pressures significantly less than 0.5 kbars. Experimental data are available which demonstrate the fluxing effect of alkalis in magnesian carbonatitic melts, permitting the magmatic crystallisation of dolomite at low pressures. Metasomatism (fertilisation) of the country rock granites was caused by a high K/Na fluid phase derived from the carbonatite - testifying to the presence of alkalis in the original carbonatite magma. It is argued that all the petrographic and geochemical features noted in the Bulhoek carbonatites can be explained through the crystallisation directly from a mantle-derived parent magma of alkalic magnesian carbonate composition similar to those produced in mantle melting experiments on natural peridotites.