

# Alkali-carbonate rich melt inclusions in magmatic minerals of the Venetia kimberlite, South Africa

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Reconstructing the composition of primary kimberlite melt is highly problematic due to processes of magma contamination and degassing, and post-magmatic alteration of kimberlite rocks. These processes greatly affect the initial concentrations of volatiles (H<sub>2</sub>O, CO<sub>2</sub>) and alkalis (Na, K). Melt inclusions trapped within primary magmatic minerals provide snapshots of pristine kimberlite melt(s) possibly prior to the modification processes listed above. This study examines the mineralogy and melt inclusions of an archetypal (or Group I) hypabyssal kimberlite from Venetia, South Africa to constrain the composition of the parental kimberlite. In this sample (BI9883), olivine is extensively serpentinised and the groundmass is dominated by calcite, Cr-spinel, perovskite, apatite, ilmenite, phlogopite, monticellite and sulphides along with abundant alteration phases (i.e. serpentine, talc and secondary calcite). Primary polyphase inclusions were studied in Cr-spinel and, for the first time in kimberlites, perovskite, apatite and calcite. All the inclusions contain polycrystalline, heterogeneous mineral assemblages of alkali-carbonates (e.g., fairchildite K<sub>2</sub>Ca(CO<sub>3</sub>)<sub>2</sub>, shortite Na<sub>2</sub>Ca<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>), chlorides (Na, K), phosphates (bradleyite Na<sub>3</sub>Mg(PO<sub>4</sub>)(CO<sub>3</sub>), apatite), sulphides, Fe-Ti oxides and phlogopite. These primary inclusions probably host the crystallisation products of a carbonate melt enriched in alkalis and poor in Si. We interpret this melt to be a pristine example of a kimberlite melt. Furthermore, for the first time in southern Africa kimberlites, shortite (Na<sub>2</sub>Ca<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>) and Na-chlorides have been detected as primary inclusions in magmatic calcite. This evidence supports previous inferences that kimberlite magmas host higher sodium concentrations than shown in bulk rock analyses. The melt inclusions in magmatic minerals of the Venetia kimberlite are analogous with the ones reported for kimberlites in the Siberian (Russia), Slave (Canada) and North Atlantic Cratons (Greenland). We therefore propose that kimberlite kimberlite melts are carbonatitic and rich in alkalis, halogens and sulphur on a global scale [1].

[1] Kamenetsky *et al.* (2014) *Earth Science Reviews* **139**, 145-167.