

Melt inclusions in co-precipitated perovskite, nepheline and magnetite in Kerimasi pyroxene-nephelinite, Tanzania

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Carbonatite and associated silicate rocks occurred in more than 500 localities in the Earth (Wooley and Kjarsgaard, 2008). Besides scientific aspects (e.g., Kjarsgaard 1998, Lee and Wyllie, 1998; Guzmics et al., 2008) many of them have great economic potential (e.g. Groves and Vielreicher, 2001). Evolution path(s) of their parental melt(s) is still ambiguous and questions have remained unanswered over the years, although, immiscible silicate and carbonate melts hosted in co-precipitated minerals of alkaline silicate rocks have been already studied (e.g. Nielsen et al., 1997; Mitchell, 2009; Guzmics et al., 2011).

In this study we have investigated a statistically significant number of melt inclusions hosted in coexisting perovskite, nepheline and magnetite in a clinopyroxene-nepheline-perovskite-magnetite-melilite rock collected at the Southern slope of Kerimasi Volcano, Tanzania. The rock shows typical igneous texture. Apatite and calcite can also be found as accessories. Nepheline hosts silicate melt inclusions however, perovskite and magnetite host melt inclusions containing droplets of immiscible carbonate and silicate melts. In general, all rock-forming minerals can be found in melt inclusions as daughter minerals; however, nepheline and clinopyroxene are the most common.

Microthermometric experiments were undertaken on nepheline- and perovskite-hosted melt inclusions. Melt inclusions show minimum temperatures for fluid-melt homogenization (into the melt phase) at 1050 °C. Many of melt inclusions were not homogenized, but decrepitated above 1100 °C. Melting of the last solid phase (e.g. clinopyroxene in nepheline-hosted melt inclusions) was detected between 1040 and 1050 °C. Using

the minimum homogenization temperature (1050 °C), heating-quenching experiments were carried out on perovskite-, magnetite- and nepheline-hosted melt inclusions in furnace.

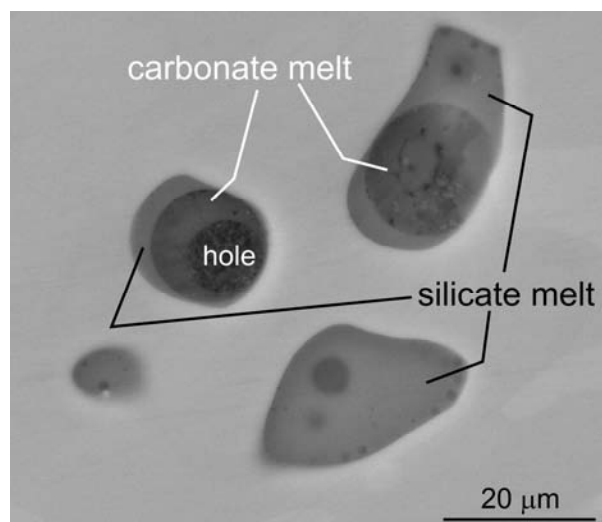


Fig. 1. Quenched (after heating to 1050 °C) melt inclusions in perovskite, backscattered electron image.

In general, nepheline-hosted melt inclusions showed quenched silicate melt and fluid bubble whereas, perovskite- and magnetite-hosted melt inclusions contained quenched silicate melt, carbonate melt and fluid bubble. These are interpreted as heterogeneously entrapped phases as their proportions are highly variable among the melt inclusions (Fig. 1). Microprobe measurements on quenched products have also been carried out for their major element composition.

Our results show, that at the early stage of melt evolution a carbonated olivine-nephelinite melt existed. We can follow evolution of this melt in a high number of melt inclusion showing enrichment in CaO and depletion in SiO₂ and

Al₂O₃, which was mainly controlled by co-precipitation of nepheline and clinopyroxene. Eventually, this chemical evolution led up to immiscibility between two alkali-rich melts: an MgO and FeO-rich silicate melt and a CaO- and P₂O₅-rich carbonate melt. Latter one could be physically separated from the system and became the parental melt of Kerimasi calcio-carbonatite (e.g., Guzmics et al. 2011). Our study suggests that immiscibility, occurred at crustal environment, can be responsible for observations worldwide namely; most of carbonatite rock is calcio-carbonatite (e.g. Le Bas, 1977).

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