Extremely alkaline carbonate melts at Oldoinyo Lengai: a melt inclusion study

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Nephelinite rock from the only active carbonatite volcano, the Oldoinyo Lengai, was selected for detailed melt inclusion study to better understand the mechanism of the formation of natrocarbonatites built up mainly by nyerereite and natrite. The studied rock contains nepheline and clinopyroxene phenocrysts. In the growth zones of nepheline we have found primary melt inclusions. Microthermometry and heating-quenching experiments of handpicked nepheline grains discovered that an immiscible (moderately peralkaline with extremely low H_2O-content) nephelinite melt and a carbonate melt coexisted and entrapped heterogeneously during the nepheline crystallization at around 800 °C. The majority of bubbles of the quenched melt inclusions are shrinkage bubbles and only a few bubbles contain very low density CO_2, suggesting almost complete outgassing before melts entrapment.

Raman spectroscopy on the unheated carbonate melts and SEM-EDS analyses on the quenched carbonate melt phases show dominantly a natrite- and subdominantly a nyerereite-normative compositions with high fluorine-content (9-14 wt. %). Fluorine plays an important role in maintaining the natrite-normative carbonate melt with 17-29 wt. % CaO in the coexsistence with the nephelinite melt. The natrite-normative carbonate compositions are proved to be fluid-originated, whereas CaO-rich nyerereite-normative compositions are melt-originated [1].

Normative $CaCO_3/(CaCO_3+Na_2CO_3+K_2CO_3)$ values of the quenched carbonates are continuous between 0 and 41.7, which indicates a mixing of a fluid-, and a melt-originated carbonate melts. This mixing might be enabled by the outgassing of volatiles (CO_2+H_2O). Our study is the first evidence for a mixing of a fluid-related natrite-normative and a melt-related nyerereite-normative melts, forming natrocarbonatites at Oldoinyo Lengai.

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