

Melt inclusions in coexisting perovskite, nepheline, magnetite and clinopyroxene in pyroxene melilitolite from Kerimasi Volcano, Tanzania

T. GUZMICS^{1*}, R.H. MITCHELL², M. BERKESI¹,
C. SZABÓ¹ AND R. MILKE³

¹Lithosphere Fluid Research Lab, Institute of Geography and Earth Sciences, Eötvös University Budapest, 1117 Pázmány Péter sétány 1/C, Budapest, Hungary (correspondence: tiber.guzmics@gmail.com)

²Lakehead University, Thunder Bay, ON P7B 5E1, Canada

³Free University, Habelschwerdter Allee 45, 14195 Berlin, Germany

We studied melt inclusions in pyroxene melilitolite from Kerimasi volcano, Tanzania. Primary silicate melt and fluid inclusions were entrapped in perovskite, magnetite, nepheline and clinopyroxene, however, perovskite usually enclosed multiphase melt inclusions containing both silicate and carbonatite melt (Fig. 1).

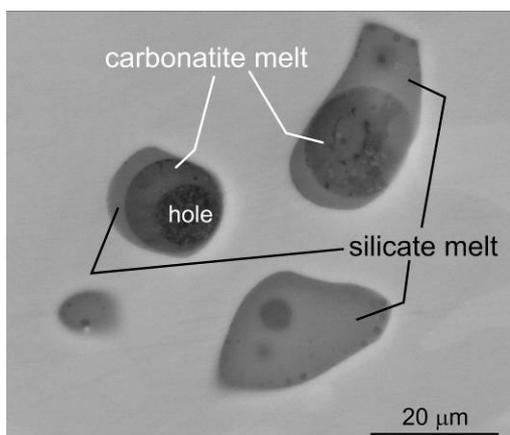


Figure 1: Quenched melt inclusions containing immiscible melts in perovskite after heating to 1050 °C.

High temperature heating experiments on melt inclusions show minimum homogenization temperatures at 1040 °C in clinopyroxene and at 1050 °C in nepheline and perovskite, which correspond to actual crystallization temperature. Nevertheless, in many cases, heterogeneous entrapment of melts and fluid prevented complete homogenization of melt inclusions. We applied furnace technique in order to produce homogenous melt(s). Melt compositions indicate an earlier formation of this rock than Kerimasi calciocarbonatite.

CO₂ sequestration and hydrothermal basalt alteration at 40-250 °C

A. P. GYSI* AND A. STEFÁNSSON

Institute of Earth Sciences, University of Iceland, 101

Reykjavik, Iceland (*correspondence: apg2@hi.is)

In order to gain insight into the geochemical processes associated with CO₂ mineralization and sequestration in basalts, a series of CO₂-water-basaltic glass reaction path experiments and numerical simulations were performed at 40-250 °C and initial *p*CO₂ of 0-20 bar, and the water chemistry and the secondary minerals studied as a function of reaction progress.

At 40-75 °C, the addition of CO₂ changes the water-basalt reaction path considerably. At low reaction progress (pH <6.5), the pH was buffered by CO₂ ionization, consumption of protons (H⁺) by the dissolving basaltic glass and proton consumption-release upon secondary mineral formation. The stable mineralogy consisted of Ca-(Mg)-Fe clays, amorphous SiO₂ and Ca-(Mg)-Fe-(Mn) carbonate (ankerite) solid solutions. The moles of carbonates and SiO₂ per moles dissolved basaltic glass was observed to increase at elevated *p*CO₂, whereas the amount of clays forming decreased. At high reaction progress (pH >8), the pH was buffered by the basalt alteration and secondary mineral formation and dissolved silica ionization. The stable mineral assemblages consisted of Mg-Fe clays, zeolites and Ca-Mg carbonates.

At 150-250 °C, the secondary mineral assemblages formed during the experiments were similar to those observed in natural geothermally altered basalts, and consisted of amorphous SiO₂, mixed Mg-Fe smectites/chlorite, zeolites and calcite. The amount of clays and a basaltic glass surface alteration layer increased in thickness with temperature, coating sometimes the entire basaltic glass surface. At 250 °C, the clay compositions were generally closer to chlorite and the basaltic glass completely altered after ~50 days, whereas at 150 °C a thin alteration layer was observed after ~125 days reaction time.

The dissolution of basaltic glass in CO₂-rich waters was found to be incongruent with the overall water composition and secondary mineralogy depending on pH, reaction progress and temperature. Competing reactions between clays (Ca-Fe smectites) and carbonates at low pH, and zeolites and clays (Mg-Fe smectites) and carbonates at high pH, control together the availability of Ca, Mg and Fe, playing a key role for CO₂ mineralization and sequestration into basalts [1, 2].

[1] Gysi & Stefánsson (2008) *Min. Mag.* **72**, 55-59. [2] Gysi & Stefánsson (2011) *submitted to Geochim. Cosmochim. Acta.*