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# Generation of alkalic silica-undersaturated melts via interaction of peridotite with chloride-carbonate liquids

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Silica-undersaturated potassic rocks, kamafugites, are believed to be products of melts generated in veined mantle source [e.g. 1] resulted from the influx of alkalic fluids into peridotites. Close association of the kamafugitic rocks with carbonatites as well as data on fluid and melt inclusions in the minerals of these rocks [e.g. 2] indicate that generation and evolution of such melts was accompanied by complex salt liquids enriched in alkali carbonates and halides, sulfur, phosphorus, etc., which served as metasomatic agents promoting the deep-seated melting. These components could be also responsible for liquid immiscibility phenomena during formation of the alkalic melts. In particular, alkali chlorides cause immiscibility in silicate and carbonate-silicate melts at pressures above 4 GPa [3].

In order to evaluate the role of chlorides and carbonates in generation of the alkalic silica-undersaturated melts, experiments on interaction of a model garnet peridotite $Fo_{63}En_{30}Prp_5Di_2$ with $CaCO_3$+$Na_2CO_3$+KCl melt were performed at 7 and 2 GPa.

At 7 GPa and temperatures $<1490^{O}$C, silica-bearing chloride-carbonate melt ($L_{CC}$) coexists with forsterite, pyrope-grossular garnet, and complex silicate (Na, K)$_2$Ca$_4$Mg$_2$Si$_4$O$_{15}$ (KNCM), which is firstly reported in high-pressure experiments. This silicate is a product of interaction of $Na_2CO_3$ and $CaCO_3$with pyroxenes, which are totally absent in the run products. Alkalic silica-undersaturated silicate melt (34-35 wt. % of $SiO_2$, 7-8 wt. % of $Al_2O_3$, 11 wt. % of $Na_2O$, 13 wt. % of $K_2O$), coexisting with immiscible $L_{CC}$, forsterite, and KNCM phase, appears at $1490^{O}$C. The MgO/CaO ratio in this first melt is about 4.5, while Cl content reaches 2 wt. %. As the KNCM phase disappears at higher temperature, the melt becomes more calcic (MgO/CaO = 0.6) and chlorine-rich (up to 3.5 wt. %). In presence of $H_2O$, the KNCM phase does not form, while an assemblage Fo+Di+Phl coexists with $L_{CC}$ below $1420^{O}$C. At this temperature, disappearance of clinopyroxene and phlogopite results in formation of alkalic silica-undersaturated silicate melt with MgO/CaO about 0.45 containing up to 2.5 wt. % of Cl.

Silicate melt ($L_S$) forming at 2 GPa contains up to 39 wt. % of $SiO_2$, is less alkalic, and contains much lower Cl content (about 1.5 wt. %). In absence of $H_2O$, such melt forms at $>1200^{O}$C via melting of the assemblage forsterite+clinopyroxene+kalsilite. This subsolidus assemblage is resulted from interaction of pyroxene and garnet constituents of peridotite with the chloride-carbonate liquid: Prp + 2En + [KCl + $Na_2CO_3$ + $CaCO_3$] = 2Ks + 7/3Fo + 1/3Di + [2NaCl + 4/3$CO_2$]. The following sequence of phase assemblages is observed within the temperature interval 1200-$1300^{O}$C: Fo+Cpx+Ks+$L_{CC}$ $\rightarrow$ Fo+Cpx+$L_S$+$L_{CC}$ $\rightarrow$ Fo+$L_S$+$L_{CC}$. All these assemblages are accompanied by the $CO_2$-rich fluid. In presence of $H_2O$, kalsilite is absent being replaced by phlogopite. The obtained temperature of solidus (i.e. slightly above $1200^{O}$C) is in a good agreement with temperatures estimated for some kamfugitic rocks [e.g. 4].

Present experiments show that presence of carbonates results in the undersaturation of the melts in silica, while immiscibility caused by chlorides assists to a strong enrichment of the melts in potassium. Being formed within metasomatised mantle peridotite in equilibrium with chloride-carbonate liquids, the melts loose chlorine during percolation through the peridotitic mantle. Nevertheless, they preserve high potassium content during their ascent.

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