# LOW-PRESSURE EVOLUTION OF MELILITE-BEARING ROCKS: AN EXPERIMENTAL STUDY

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Strongly silica-undersaturated high-calcium alkaline magmas are important for understanding the genesis and evolution of melilite-bearing rocks. Here we present the results of 1 bar melting experiments with synthetic larnite-normative compositions. One of the bulk compositions (#1, see table) used as a starting material corresponds to that of magma evaluated on the basis of melt inclusions study in early liquidus minerals of Kugda intrusion (Maimecha–Kotui region, Polar Siberia) olivinites, the other mixture (#2) is similar to average of Kugda massif turjaitic dykes. The principal difference between (1) and (2) melts is the (Na + K)/Al value (agpaitic coefficient). We consider these compositions to be possible parental liquids for the whole Kugda intrusion. We have also studied the crystallization of composition (1) doped by small amounts (1 wt. %) of fluorine (to imitate the OH groups) and the influence of various redox conditions on the turjaitic melt evolution. Loop technique was used to avoid iron losses. Oxygen fugacity in the furnace was regulated and checked by solid electrolytic cells. The composition of phases was determined by EMPA.

*Compositions of starting mixtures*

| | $SiO_2$ | $TiO_2$ | $Al_2O_3$ | FeO | MgO | CaO | $Na_2O$ | $K_2O$ | $P_2O_5$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 39.89 | 12.41 | 5.13 | 4.16 | 8.20 | 24.15 | 3.50 | 1.92 | 0.63 |
| 2 | 40.57 | 2.34 | 10.16 | 9.63 | 10.23 | 22.25 | 2.86 | 1.54 | 0.49 |

Phases crystallizing from high-calcium alkaline melts are: olivine (or spinel, in air), melilite, clinopyroxene, perovskite, F-phlogopite (in fluorine doped runs), magnetite and nepheline–kalsilite solid solution. Crystallization sequences of phases depend on starting composition and redox conditions, but in all cases at QFM buffer olivine and melilite are the first liquidus phases and melilite is the predominant phase. At high oxygen fugacity olivine is absent, spinel and clinopyroxene are the first phases and clinopyroxene predominates among the crystalline phases. It is high in Fe and anomalously low in silica (mere 42 wt. %). Increase in the agpaitic coefficient of the melt results in remarkable decrease in clinopyroxene stability. This indicates lower silica activity in agpaitic melt. Increase in oxygen fugacity has reverse influence on clinopyroxene stability. Another peculiarity of agpaitic melts is extremely high K/Na value for residual liquids.

The trend of melt changes during the crystallization. Initial crystallization of olivine and melilite results in rapid growth of Fe/Mg values, while Na–Fe ratio changes insignificantly. In the next stage (as the role of clinopyroxene increases) Na/Fe values rise steeply, while Fe/Mg values are nearly constant. Similar trends of melt evolution are observed in natural volcanic and plutonic suites (Nyiragongo, Oahu, Kugda).

The results of these experiments permit to explain the diversity of melilite-bearing volcanic and plutonic rocks by crystallization differentiation of high-calcium alkaline parental magma.