

EXPERIMENTAL INVESTIGATION ON THE INTERACTION OF CARBONATE MELTS WITH UPPER MANTLE ROCKS.

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Melting phase relations in the joins diopside*2 pyrope*6 enstatite (DPE)- K_2CO_3 and fluorphlogopite-K,Na,Ca,Ba-carbonate have been studied at 20 kbars. Experiments were run on the piston-cylinder apparatus. An accuracy of temperature measurements were $\pm 10^\circ C$, that of pressure measurements ± 1 kbar.

DPE composition in the subsolidus region ($1200^\circ C$) interacts with K_2CO_3 by the following reaction: $Di+2Py+6En+2K_2CO_3=6Fo+4Lc+CaMg(CO_3)_2$ (1) i.e. as a result of the solid phase reaction, K concentrates in an alumo-silicate phase. Melting in the join DPE- K_2CO_3 ($1220-1600^\circ C$) proceeds with the formation of immiscible silicate and carbonate liquids coexisting with forsterite (to about 35wt% K_2CO_3) and (or) leucite and calcite in the subliquidus region. No complete partition of immiscible liquids is observed in the runs. Silicate melt when quenched yields glass with fine inclusions of a carbonate phase (quenching carbonate liquid). We failed to perform satisfactory microprobe analyses of the carbonate phase. However, the characteristic low (<1 wt%) contents of SiO_2 and Al_2O_3 have been determined in the latter. This allowed to calculate compositions of the carbonate liquid from the composition of coexisting silicate liquid and estimate partition coefficients of the main elements (the ratio (wt%) of oxide concentration in the carbonate melt to that in silicate melt): $K^{Mg}_D=0,15-0,3$; $K^{Ca}_D=0,3-0,5$; $K^K_D=3-7$. K_2O concentration in the carbonate liquid reaches 50 wt%.

Since reaction (1) yields forsterite, the experiments performed model the interaction of potassium-rich carbonate melts with lherzolite assemblage. At temperatures below the silicate liquid formation, alkalis are bound into aluminosilicate phases and carbon dioxide is bound into Ca-Mg carbonates. The interaction of lherzolite and alkaline-carbonate melt results in formation of coexisting silicate and carbonate melts (at higher temperatures), whereas alkalis preferentially concentrate in the carbonate liquid.

Experiments in the join fluorophlogopite - K, Na, Ca, Mg, Ba -carbonate (K_2CO_3 -9.8wt%, Na_2CO_3 -5.4%, $MgCO_3$ -20.3%, $CaCO_3$ -60.1, $BaCO_3$ -4.4%) showed that melting of compositions involving at least to 66 wt% carbonate leads to formation of homogeneous melt. In case the carbonate content is < 50wt% the melt gets quenched into the transparent slightly opalescent glass. At higher carbonate concentrations, the sample after the experiment is a glassy aggregate composed of silicate glass and very fine carbonate segregations.

Results of two experimental series when compared show that in the system K,Na,Ca,Mg,Al,Si II CO_3^{2-} , F^- there exist both the areas of compositions whose melting results in formation of immiscible silicate and carbonate melt and areas of homogeneous melts. High fluorine concentrations are characteristic of the latter.

Taking account of the crystallochemical similarity of F^- and OH^- , water presence can be suggested to prevent the liquation of carbonate-rich silicate melt.

Generation of carbonate melts is likely to be related to the oxidation processes of deep seated methane ($CH_4 + O_2 = CO_2 + H_2O$). Homogeneous carbonate-silicate melts of kimberlite type form in the presence of water and fluorine. The long-term existence of magmatic chambers at high temperatures may lead to 'disication' and oxidation of melts due to the dissipation of hydrogen, because at high temperatures any magmatic system is virtually open for hydrogen. A decrease in water content in the melt will cause the appearance of immiscible liquids which are likely associated with carbonatite and lamproite magmas.