

EXPERIMENTAL SIMULATION OF ALKALI-CARBONATE METASOMATISM AND MELTING OF THE MANTLE: THE FEATURE OF THE CHEMISM AND PHASE RELATIONSHIP

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Close association of alkaline and ultrabasic rocks, carbonatites, apatitic and sulfidic mineralization, features of structure testify about mantle a source and the important role alcalic-carbonaceous fluids in genesis of these rocks.

Formation alkaline silicate, carbonaceous and sulfidic melts, phase relationship, behaviour of the titan, phosphorus, sulphur and zircon has been experimentally studied at pressure 3.9 GPa, temperature 1250°C in system peridotite-basalt (eclogite)-alcalic-carbonaceous fluid with additives in quality accessory minerals, apatite, nickel-containing pyrrhotite, ilmenite, zircon.

Experiments were carried out using of apparatus high pressure (piston cilinder and anvil with hole) by a quenching technique. It was used two ampoules (platinum and peridotite, content basalt powder) method. Duration of experiments was 6-8 hours. Products of experiments were studied on electronic scanning microscope Tescan VEGA TS 5130MM with YAG detector of secondary and reflected electron and energy-dispersive the x-ray microanalyzer with semi-conductor Si (Li) detector INCA Energy 350.

The first results have shown, that at partial (up to 10 %) melting of peridotite association a garnet (Ga)-phlogopit (Flog)-clinopyroxene (Cpx)-zircon (Zr) and the X-phase (not diagnosable the titan and phosphorus-containing the alumo-silicate phase, estimated as Ti-rich Cpx)-sulfide was cemented by intergrain silicate glass with inclusions of carbonatic phases (fig. 1).

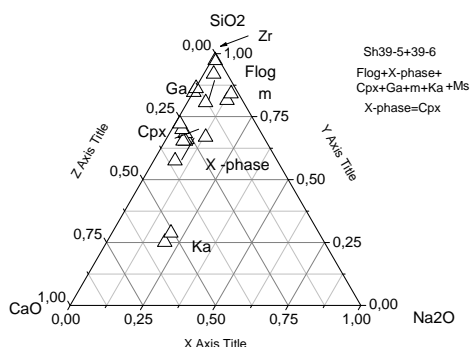


Fig.1. Composition of coexisting phase

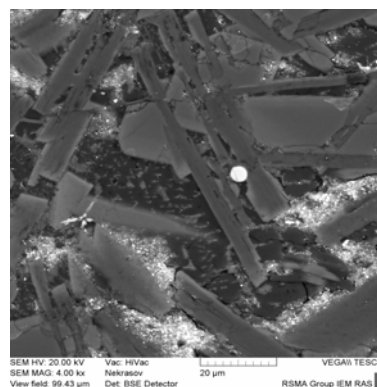


Fig.2. BSE photo of experimental sample: metasomatism and partial melting of eclogite. T=1250°C, P= 4.0 GPa

The morphology, structure and relationship of glass, inclusions of carbonatic and sulfidic globules specify in existence in the conditions of experiment immiscibility silicate, carbonate and sulfidic melts (fig. 2).

The composition of silicate melt answered phonolite, carbonaceous melts it is essential calciferous composition with an impurity of alkaline metals and silicate components (fig. 3).

Solubility of zircon in silicate melts reached 0.8 wt. % ZrO_2 , in co-existing carbonaceous melt - 1.5 wt. %. Concentration TiO_2 and P_2O_5 in silicate melt reached 2 wt. %, in carbonaceous melt - 1.7 wt. % TiO_2 and up to 14 wt. % P_2O_5 (fig. 4, 5). Concentration of sulphur in these melts did not exceed 0.2 mac. %.

From minerals of liquidus the main concentrators of the titan and phosphorus were the X-phase and phlogopite - up to 8 wt. % TiO_2 and up to 3 wt. % P_2O_5 in the X-phase, up to 6 wt. % TiO_2 and to 2.5 wt. % P_2O_5 in phlogopite. Absence ilmenite and apatite in experimental samples under the studied conditions is obviously caused by their high solubility in co-existing phases.

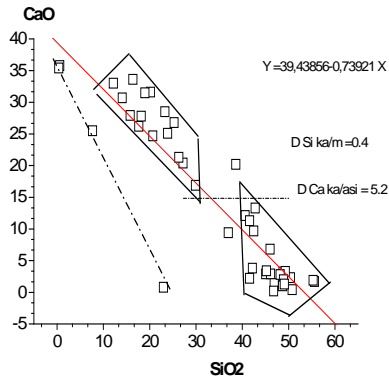


Fig.3. Composition of silicate (m) and carbonate (ka) melts

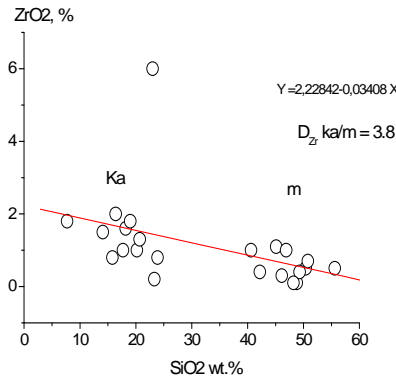


Fig.4. Solubility of zircon (wt.% ZrO_2) in silicate (m) and carbonate (ka) melts

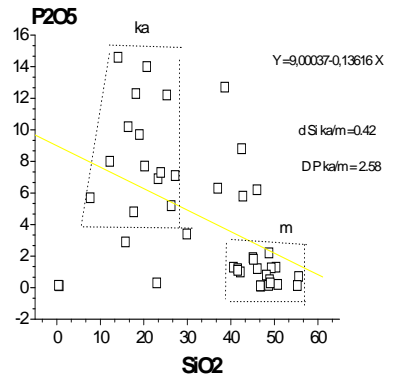


Fig.5. Concentrations (wt.%) of SiO_2 and P_2O_5 in silicate (m) and carbonate (ka) melts

The composition of X-phase is similar to composition of Cpx, but X-phase enrich in TiO_2 and deplete in SiO_2 (fig. 6).

The partition coefficient of oxides some elements between silicate and carbonaceous melts $D_{ka/si}$ increasing from SiO_2 ($D < 1$) to CaO ($D > 10$) (fig. 7).

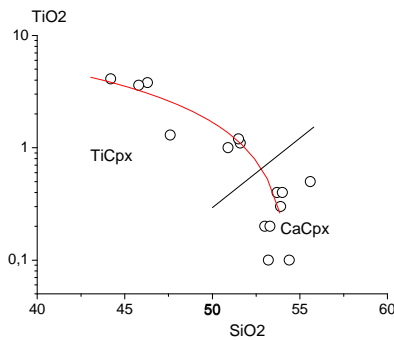


Fig.6. Concentration of SiO_2 and TiO_2 (wt.%) in Ca-bearing (Cpx) and Ti-bearing (TiCpx) clinopyroxenes. X-phase – Ti-bearing clinopyroxene

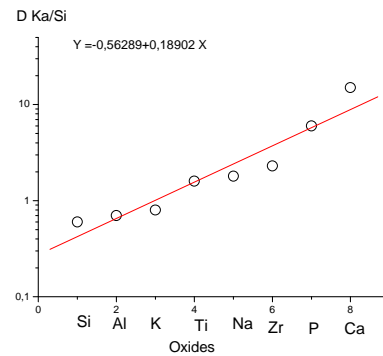


Fig.7. The partition coefficient $D_{Ka/Si}$ of oxides macro and micro elements between carbonate (Ka) and silicate (Si) melts

With pressure decline concentration of saturation silicate melt phosphorus (solubility of apatite) decreased. At pressure 0.5-1.8 GPa at concentration in alkaline silicate melts 0.9-1.2 wt. % P_2O_5 their saturation by phosphorus with formation enriched by calcium phosphatic melts, immiscibility with the silicate was observed (fig. 8).

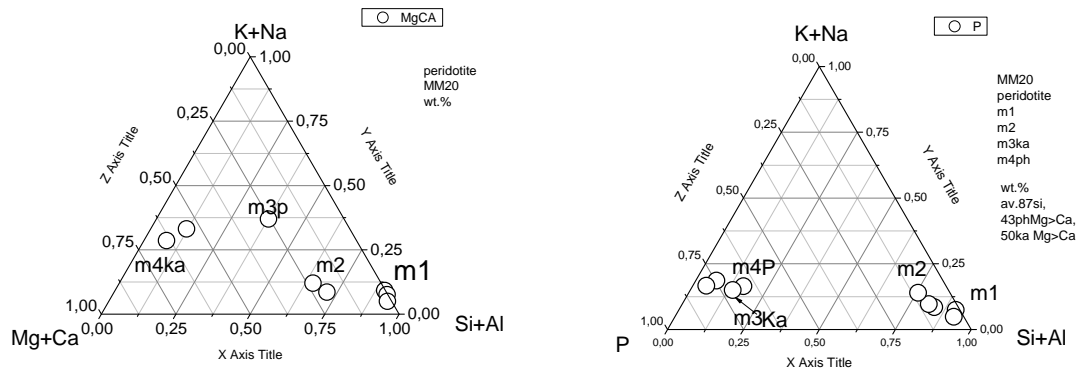


Fig.8. Composition of coexisting silicate (m1, m2), carbonate (m3ka, m4ka) and phosphate (m3p, m4p) melts

Reduction of solubility of apatite in alkaline silicate melt at pressure decline promotes silicate-phosphate stratification and formation of apatite mineralization at introduction of mantle magmas into the earth crust.

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