Magmatic systems at high pressures

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Phase relationships of diamond-bearing carbonate-silicate rocks from the Chagatay massif, Uzbekistan (experiment at 7 GPa).

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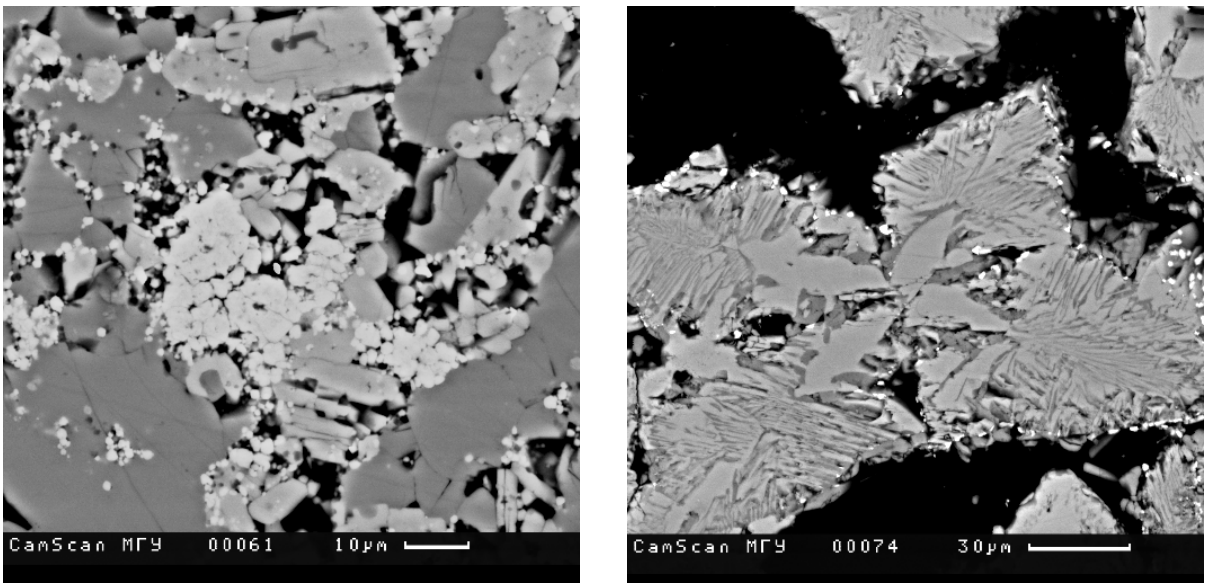
The Chagatay trachite-carbonatite massif is located in South Nuratau (West Uzbekistan). A special interest to this massif is associated with recent findings of diamond in the melanocratic carbonatites (Djuraev, Divaev, 1999). The goal of our research was the experimental simulation of high-pressure mineral assemblages from the carbonate-silicate rocks and the study of crystallization factors of carbonate-silicate magmas at high PT-parameters (P=7.0 GPa, T=1200-1700°C).



a) b)

Fig.1. The results of experiment in carbonate-silicate system at P=7.0 GPa. a) – subliquidus assemblage of garnet (white), clinopyroxene (grey), apatite (light-grey) and calcite (dark), 1200°C; b) – garnet crystals in matrix represented by tiny intergrowths of carbonate and silicate phases, 1720°C.

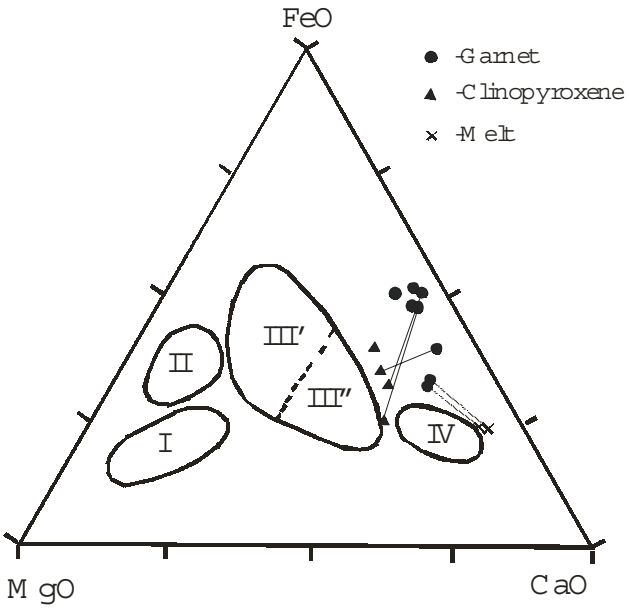


Fig. 2. Comparison of the experimental data with the nodules of garnet – clinopyroxene rocks from kimberlites. The fields of garnet from pyrope peridotites (I), garnet pyroxenites (II), ferromagnesian eclogites (III'), peraluminous eclogites (III") and grossular-spinel-diopside rocks (IV) are shown.

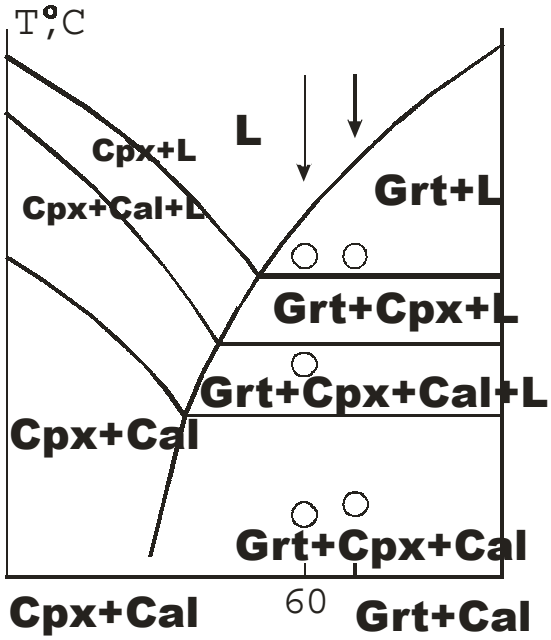


Fig. 3. Phase relationships in carbonate-silicate system at P=7.0 GPa and T=1200-1720°C (for the two natural samples of melanocratic carbonatites 23, 79).

The research was conducted with the apparatus of "anvil-cell" type NL-13T with a cell made of lithographic stone. The pressure measurement precision was ±0.1 GPa.

The phase relationships were experimentally studied in carbonate-silicate system at P=7.0 GPa and T=1200-1720°C for the two natural samples of melanocratic carbonatites – 23 and 79 (Cpx, Kfs, Cal, Bt, Ab, Mag).

The conditions and results of the experiments are presented in table and shown in figs. 1, 2.

No. sample	No. run	Temperature, °C	Duration, min	Mineral assemblage
23	648	1220	125	Cpx+Grt+Cal+Ap
23	652	1720	20	Grt_Cpx+L
79	640	1200	120	Cpx+Grt+Cal+Ap
79	641	1500	60	Cpx+Grt+Cal+L
79	642	1720	20	L+Grt++Cal

A subsolidus assemblage consisted of garnet of almandine-grossular composition with traces of pyrope, clinopyroxene of diopside-hedenbergite raw with traces of potassium (up to 0.54 wt.% K_2O), calcite and apatite (fig. 1a) is formed at 1200°C. In the T=1500°C run the garnet contains multiple tiny non-stoichiometric inclusions (obviously melt). The garnet crystals with the versus (progressive) zonality in matrix represented by tiny intergrowths of carbonate and silicate phases are observed in the T=1700°C run. The latter intergrowths are due to rapid quench of the carbonate-silicate system during the experiment.

As follows from the diagram (fig. 2) where the garnet compositions from the mantle rocks constituting nodules in kimberlite tubes are summarized the experimentally obtained silicate assemblage corresponds to calcium-rich eclogites and grossular-spinel-diopside rocks observed as nodules in kimberlite tubes. A preliminary phase diagram in carbonate-silicate system at P=7.0 GPa and T=1200-1720°C was plotted by the results of the Chagatay massif experimental studies (fig. 3).

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