EXPERIMENTAL STUDIES OF CARBONATE – SILICATE MELTING RELATIONS IN THE $K_2Ca(CO_3)_2$ – DIOPSIDE – PYROPE AT 3.8 GPa IN CONNECTION WITH GENESIS OF KOKCHETAV DIAMOND – BEARING ROCKS

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Experimental studies of melting relations of the carbonate – silicate system $K_2Ca(CO_3)_2$ – diopside $CaMgSi_2O_6$ – pyrope $Mg_3Al_2Si_3O_{12}$ were carried out at 3.8 GPa to explore the version that diamonds of Kokchetav metamorphic complex (Kazakhstan) have magmatic origin. The version is based on the findings of diamond – bearing carbonate – silicate rocks composed of dolomite, potassium – rich clinopyroxene and pyrope – grossular garnet [1, 2]. Additional arguments deduced from high-pressure synthesis of potassium – rich clinopyroxenes in K_2CO_3 – diopside mixtures[3] and $K_2Mg(CO_3)_2$ – $CaSiO_3$ – Al_2O_3 system [4], discovery of potassium – rich fluid-carbonatitic inclusions in Kokchetav diamonds [5], and experimental crystallization of diamonds in multicomponent carbonatitic melts of natural compositions [6]. It was shown that $K_2Ca(CO_3)_2$ composition is most representative for primary fluid inclusions in natural diamonds [7] and effective as a medium for diamond crystallization in melted state [8].

The studies of melting relations of the $K_2Ca(CO_3)_2$–diopside–pyrope system were carried out in the $K_2Ca(CO_3)_2$ – diopside$_{50}$pyrope$_{50}$ and $Di_{85}[K_2Ca(CO_3)_2]_{15}$ – $Py_{85}[K_2Ca(CO_3)_2]_{15}$ joins at 3.8 GPa. For the $K_2Ca(CO_3)_2$ – $[CaMgSi_2O_6]_{50}$ $[Mg_3Al_2Si_3O_{12}]_{50}$ join, complete melting was found to occur in the 1200–1600^{o}C temperature interval at 3.8 GPa. In the course of quenchimg, the melts form intermitent accretions of phlogopite, monticheliite and carbonates. Diopside as liquidus phase appears at 1200^{o}C. No evidence of the effect of carbonate – silicate liquid immiscibility was recognized. For the $Di_{85}[K_2Ca(CO_3)_2]_{15}$ – $Py_{85}[K_2Ca(CO_3)_2]_{15}$ join, garnet of $Mg_{2.0\text{-}1.0}Ca_{1.0\text{-}2.0}Al_2Si_3O_{12}$ composition and clinopyroxene of diopside composition (K_2O content is negligibly small) are formed as liquidus phases at 1200^{o}C. Subsolidus assembly is represented by clinopyroxene, garnet and carbonates.

Taking into account that diamonds crystallize in K-Ca-carbonate melts oversaturated with carbon, it can be seen that the natural diamond – bearing carbonate – silicate assembly is reproducible in high-pressure experiment. This provides new essential grounding in the magmatic version of diamond genesis in Kokchetav – type deposits, the complete geological history of which was influenced by scale processes of the mantle dynamics.

1. Sobolev N.V., Shatsky V.S. (1990). Nature, 343, N 6259, 742-746.
2. Perchuk L.L., Yapaskurt V.O. and Okay A. (1995). Petrology, 3, N 3, 267-309.
3. Harlow G.E. (1997). Am. Mineral., 82, 259–269.
4. Matveev Yu.A., Litvin Yu.A., Perchuk L.L., Chudinovskikh L.T., Yapaskurt V.O. (1998). Experiment in Geosciences, 7, N. 2, 6 –7
5. De Corte K., Cartigny P., Shatsky V.S., Sobolev N.V., Javoy M. (1998). Geochim. Cosmochim. Acta, 62, 3765-3773.
6. Litvin Yu.A., Zharikov V.A.(1999). Doklady Earth Sciences, 367A, 6, 801-805.
7. Schrauder M, Navon O.(1994). Geochim. Cosmochim. Acta, 58, N 2, 761-771.
8. Litvin Yu.A., Aldushin K.A., Zharikov V.A. (1999). Doklady Earth Sciences, 367A, N 6, 813-816.