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Diamond-bearing Rocks among Mantle Xenoliths in Kimberlites as Indicatory for the Chambers of Diamond-parental Carbonatite Magma

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Origin of diamond-bearing peridotite and eclogite rocks in kimberlites is cleared up using mantle-carbonatite model of diamond genesis (Litvin, 2007, 2009, 2013). Data of analytical mineralogy of primary inclusions in diamonds and results of physicochemical experiments on syngenetic diamond and inclusion phase relations are co-ordinated in this model (Litvin et al., 2012). It proved that diamond-parental media are presented by changeable carbon-saturated peridotite-carbonatite and eclogite-carbonatite melts. The melts are capable to form not diamonds only but their major and minor inclusions. The upper mantle is mainly composed of diamond-free peridotites which dominate over eclogites as 9 to 5 % (Mathias et al., 1970). However diamond-bearing peridotites and eclogites occur rarely as demonstrated for S.Africa and Yakutia (Sobolev N., 1977). Nevertheless, origin of diamond-bearing rocks belongs to key problems of genetic mineralogy of diamond and mantle petrology due to dissimilar physicochemical and environmental conditions of formation of comparatively diamond-free rocks. Symptomatic that garnets included in diamond and these of diamond-bearing eclogite are compositionally similar (Sobolev V. et al., 1972). Garnets of diamond-bearing eclogites, inclusions in diamonds and intergrowths with them are marked by increased Na_2O content (0.10-0.22%) because of Na-majorite component $Na_2MgSi_5O_{12}$ (Bobrov & Litvin, 2011). Peridotitic garnets of diamond-bearing rocks, inclusions and intergrowths are indicated by high Cr_2O_3 and low CaO content over diamond-free ones. This compositional dissimilarity is compatible with formation of diamond-bearing rocks, inclusions and intergrowths in chambers of partially melted peridotite-eclogite-carbonatite-sulphide-carbon system of changeable composition. However, diamond-free rocks are products of upper-mantle magmatism based on carbonatite-free peridotite-eclogite-sulphide-carbon system. Chambers of diamond-parental carbonatite magma may originate and evolve by: (1) metasomatic-magmatic stage resulted in partial carbonatization of mantle peridotite under attack of K-CO_2-bearing metasomatic agents and generation of carbonate melts; (2) dissolving-magmatic stage when major and accessory minerals of peridotite host-rock, volatiles and carbon dissolve in carbonate melt whereas insoluble sulphide phases penetrate into melts; eventually, completely miscible peridotite-carbonatite-carbon magma parental for diamond and paragenetic minerals (hosting xenogenetic sulphide minerals and melts) are formed; (3) fraction-crystallization stage (in chamber consolidated into a self-dependent body) during natural cooling of parental magma up to solidus temperature; the cooling activates physicochemical control that is created by PT-phase relations for the parental magma composition, i.e., syngenesis phase diagram on a representative polythermal section of peridotite-eclogite-carbonatite-diamond system at 7 GPa under conditions of fractional crystallization (Litvin, 2013). Parental carbonatite melts, while compositionally evolve under fractional crystallization, are physicochemically capable to form diamond and sequentially minerals of peridotitic and eclogitic parageneses (presented as primary inclusions in diamonds). Paragenetic peridotite-eclogite transition in the course of ultrabasic-basic fractional evolution of parental melts is revealed in physicochemical experiments as the effect of “peridotite-to-eclogite” tonnel (Litvin, 2013). Diamond-bearing peridotite and eclogite rocks and intimate mineral intergrowths with diamond are also formed in the chambers of diamond-parental carbonatite magmas under these physicochemical conditions. Diamond-free rocks among mantle xenoliths in kimberlites represent samples of the enclosing host-rocks for the chambers of diamond-parental carbonatite magma. Support: grant of the RF President #MK-1386.2013.5, RFBR grants 12-05-33044, 13-05-00835 and 14-05-00537.