



Origin of diamond and growth inclusions thereof on evidence derived from physicochemical experiment

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The conception of carbonate-silicate parent media for the bulk of mantle-derived diamonds (Litvin, 2007) is compatible with a great body of mineralogical data on substances captured in situ by diamonds from their growth melts. Also, the conception is in excellent agreement with the results of physicochemical experiment based on the criterion of diamonds and their inclusions syngensis. The criterion reveals the behavior of growth melts under diamond formation. The multi-component diamond-forming media are changeable by contents of major and minor components, but bounded by carbonatite compositions. The generalized composition of the parent media, which fragments are included into natural diamonds, is revealed by the multi-component heterogeneous system $MgO - CaO - FeO$ (Fe, Fe_2O_3) – $MnO - NiO$ (Ni) – $Na_2O - K_2O - Al_2O_3 - Cr_2O_3$ (Cr) – $TiO_2 - ZrO_2 - SiO_2 - P_2O_5$ – CuS (Cu_2S) – FeS (Fe_2S) – NiS – KCl – $NaCl$ – SiC – $Fe_3C - CO_2$ (CO, CH_4) – $H_2O - C$. The principal mineralogical responsibility in diamond genesis appertains to carbon solutions in completely miscible melts of the major carbonate and silicate components (the silicate components belong to both peridotite-pyroxenite and eclogite-grospydite parageneses). The growth melts contain the minor components including admixed soluble components and phases (oxides, phosphates, chlorides, compounds of the $C - O - H - N$ fluid system, etc.) as well as coexisting insoluble immiscible solid and liquid phases (sulfides, metals).

On the basis of carbonatite (carbonate-silicate) conception, genetic classification of growth inclusions of minerals, melts and fluids in mantle-derived diamonds has been developed (Litvin, 2009). The classification reveals origin of the inclusions by clearing up their physicochemical links both with the major components of carbonate-silicate growth melts and minor soluble and insoluble components and phases which are contained therein.

1. The major silicate, alumina-silicate and carbonate components are responsible for origin of inclusions of silicate and alumina-silicate minerals of peridotite-pyroxenite and eclogite-grospydite parageneses, carbonate minerals and carbonatite melts; the inclusions were originated in the growth melts and trapped in situ during diamond-forming process.

2. The admixed soluble oxide, some silicate and alumina-silicate, phosphate, partially chloride components are responsible for origin of inclusions of oxide, rarely occurring silicate and alumina-silicate minerals, apatite, chlorides; the inclusions were originated in the growth melts and trapped in situ.

3. The admixed soluble components of $C - O - H$ fluid are responsible for origin of inclusions of fluid phases – water, carbon dioxide, methane, etc.; the components were trapped in situ as dissolved constituents of carbonate-silicate melts, then released into their own phases under solidification of the growth melts and formation of the assemblages of carbonates, silicates, phosphates, oxides, sulfides, chlorides, water, carbon dioxide, occasionally methane at PT parameters lower than these at diamond formation.

4. Sulfide and metal minerals and melts, insoluble in carbonatite melts and completely immiscible with the melts, are responsible for origin of inclusions of sulfides and metals; the inclusions were not originated in the growth melts and belong to the foreign products being present at the melts, but were trapped in situ during diamond-forming process.

5. Carbon dissolved in the carbonatite growth melt is responsible for inclusions of thermodynamically unstable graphite phase which was formed and trapped in situ.

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References

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