

## Experimental view on mineral inclusions of “mixed” paragenesis in lithospheric diamonds

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The natural diamonds could be formed during reduction of carbonatite melt [1], which can be derived by partial melting of carbonated eclogites in subducted slab [2-3]. The partial reduction of this melt should cause precipitation of silicate solutes simultaneously with diamond.

Experimental reconstruction of the composition of the deepest known melts (kimberlites) [4] has shown that the liquid coexisting with garnet lherzolite mineral assemblage in the mantle source region contains (mol%): SiO<sub>2</sub> = 9, FeO = 6–7, MgO = 23–26, CaO = 16, Na<sub>2</sub>O = 4, K<sub>2</sub>O = 1, and CO<sub>2</sub> = 30–35 suggesting essentially carbonatitic composition of primary kimberlite melt similar to that of kimberlite-associated diamondiferous magnesiocarbonatites [5] in terms of CaO–MgO–FeO–SiO<sub>2</sub>–CO<sub>2</sub> system.

Under high-pressures (> 3 GPa) most of carbonate-silicate systems have *T-X* phase diagrams with eutectic shifted to carbonate component. Thus, under mantle pressures carbonate melts act as a solvent for refractory silicate minerals. Partial reduction of carbonate component of carbonate-silicate melt during its interaction with reduced iron saturated ambient mantle decreases the amount of solvent. As a result, carbonate-silicate melts become saturated with silicate minerals. Thus, diamond crystallization should be accompanied by nucleation and growth of silicate minerals.

Experimental results at 6.5 GPa and 1500 °C suggest that the decreasing bulk CO<sub>2</sub>, which accompanies reduction, changes the mineral assemblage co-precipitating with diamond in following sequence: eclogite (Coe + Cpx + Grt) → pyroxenite (Cpx + Opx + Grt) → lherzolite (Ol + Opx + Cpx + Grt) → wehrlite (Ol + Cpx + Grt) [4]. This would explain the formation of diamonds from group A eclogite with mineral inclusions of “mixed” paragenesis, where two-phase coesite + clinopyroxene (Jd<sub>7</sub>Di<sub>85</sub>En<sub>5</sub>Fs<sub>3</sub>) inclusions and garnet (Prp<sub>74</sub>Alm<sub>17</sub>Grs<sub>9</sub>) inclusions are located at the central zone and olivine (Fo<sub>93</sub>) inclusions are much closer to periphery [6-7]. In our study observed clinopyroxene with close composition (Jd<sub>10</sub>Di<sub>83</sub>En<sub>3</sub>Fs<sub>4</sub>) in coexistence with coesite at bulk CO<sub>2</sub> of 31 wt%, whereas olivine appears at bulk CO<sub>2</sub> of 15–23 wt% (Fig. 1) [4].

Thus, successive decrease of bulk CO<sub>2</sub> during reduction of carbonate-silicate melt should change assemblage of minerals co-precipitating with diamond, from coesite-bearing eclogitic toward olivine-bearing peridotitic.

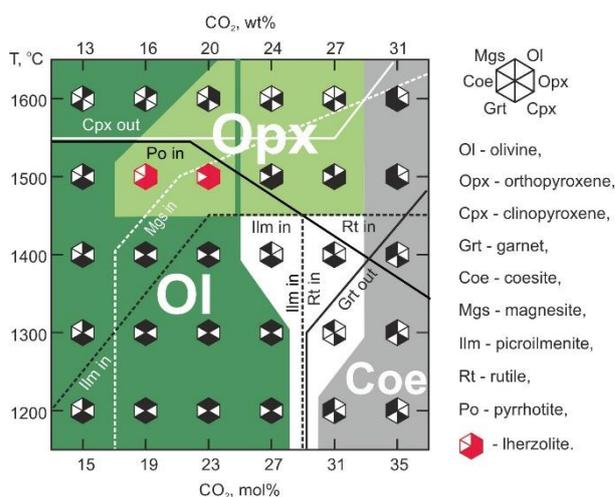


Figure 1. The temperature-bulk CO<sub>2</sub> plot illustrating mineral assemblages coexisting with melt during partial melting of anhydrous Udachnaya-East kimberlite at 6.5 GPa versus temperature and bulk CO<sub>2</sub> content.

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