DIAMONDIFEROUS ECLOGITES FROM YAKUTIA: EVIDENCE FOR A LATE AND MULTISTAGE FORMATION OF DIAMONDS

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Investigation of representative collections of diamonds from different kimberlite pipes of Yakutia by birefringence, photo- and laser-luminescence shows that near 50% of diamonds grew in single-stage processes. However, complicated and multistage history of growth has been noted for part of diamonds as peridotitic and eclogitic paragenesis, that is manifested in zonal growth of diamonds and resorption, deformation or cleavage of crystals and their later regrowth.

The results of investigation of large crystals of diamonds of octahedral external form, show that their central zones may have different shape: cubic, rounded, cubo-octahedral or octahedral. This evidences that diamonds have a multistage and interrupted growth, which responds to environmental (Sunagava, 1984; Bulanova , 1995: Spetsius, 1995) and P-T condition changes and probably to variations in volatile components.

Some petrologic evidence for multistage formations of diamonds in kimberlites and mantle xenoliths are: (1) sharp boundaries between zones having different nitrogen content and aggregation stages are observed in some diamonds (Bulanova, in press); (2) big variation and difference in carbon isotope composition of inner and outer parts of diamond crystals; (3) abundance of sulfides as inclusions in diamonds and heterogeneity of sulphur isotope compositions; (4) regularities of distribution of inclusions in volume of crystals; (5) finding of combined associations of inclusions of eclogitic and peridotitic paragenesis in one crystal; (6) a large variation in Pb isotopic compositions of sulfides within a single diamond crystal (Rudnick et al., 1993).

Estimations of ages (Richardson, 1986: Richardson et. al., 1990) suggest that diamonds might have formed in a long period of the Earth history, especially diamonds of eclogitic paragenesis. Discovery of inclusions of partially recrystallized silicate melt in diamonds of eclogitic paragenesis and high content (by an order of magnitude) of volatile components has been noted in these diamonds in comparison with those of peridotitic paragenesis.

The results of investigation of microinclusion in cubic diamonds show their unusual composition, which corresponds with partially crystalized silicate melt products having high content of volatile components, that suggests a different mechanism of growth of cubic diamonds and their difference from octahedron crystals. At the same time finding of cubic diamonds only in kyanite or other high aluminous xenoliths in different pipes of Yakutia and South Africa leaves no doubt about their origin in eclogitic environment.

Late growth of diamonds has been recorded in some xenoliths of diamondiferous eclogites from the Udachnaya kimberlite pipe. In most part of samples these diamonds are small cubes, but octahedra occur in some xenoliths too. Later origin of diamonds in part of xenoliths most probably is connected with process of partial melt of eclogites, which is widespread in eclogite xenoliths and is possibly related to global mantle metasomatism (Spetsius and Serenco, 1990).

Coats on some eclogitic diamonds and cubic crystals with fibrous structure were formed by an abnormal mechanism of nucleation under conditions at high degree of carbon supersaturation (Bulanova, in press). Such condition may be realized in the last stages of partial melting process (when partial melt was enriched in carbon) that sometimes is possible to observe in eclogite xenoliths and that is proved by development of calcite and other carbonate minerals in crystallized partial melting products.

Some other petrographic and petrologic indications of the late formation of diamonds in eclogites are discussed. It is proposed that late growth of diamonds in eclogite xenoliths is connected with partial melting and metasomatism of mantle rocks by active role of volatile components. This process might have taken place in different periods of mantle evolution and in some cases was probably associated with fluids interaction of mantle substance (rocks) that preceded the development and intruding of kimberlitic melts.

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