EXPERIMENTAL SIMULATION OF DIAMOND GENESIS

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According to the therbarometric data the majority of natural diamonds crystallized at the temperatures 900-1400°C and pressures 50-60 kbars. It was experimentally shown that diamond formation at P-T parameters occurs only in presence of the native transitional metals. However, the first supposition that natural diamonds crystallized from the metal-carbonic metals was not admitted by geologists. Our experimental data allowed us to examine this problem more groundly.

The largest differences from the natural diamonds can be observed in the diamonds produced by synthesis from graphite. The differences are stipulated by high speed of carbon transportation from graphite to diamond that is not typical to the natural processes. Different speeds of diamond growth may be experimentally realised by method of recrystallization of diamond in the metal-carbonic systems. Using this method, and also combining it with the following partial dissolution of crystals, there were obtained the majority of morphological analogs of natural diamonds. The properties of the recrystallized diamonds are close to the natural ones. They differ from the natural diamonds in form of coming in structure of admixtured nitrogen and by high content of metal inclusions.

The differences between the natural and recrystallized diamonds disappear after the swelling of recrystallized diamonds at high P-T parameters. Metal inclusions, unlike sulphide or silicate, migrate at high temperatures in volume of the diamond crystals, and may come to the surface of the crystal; it leads to purification of the crystal from that inclusions. At high P-T parameters the nitrogen C-centers in the synthetic diamonds convert into the A-centers, which are typical to the natural diamonds.

It can be supposed, that crystallization of the natural diamonds occurred in the complex silicate-sulphide-metal-carbonic systems. This process is experimentally demonstrated by the diamond synthesis from the sulphide-graphite, fayalite-graphite and magnetite-graphite mixtures, which were partially reduced by hydrogen or titan at P-T parameters of the diamond stability. It was also shown the possibility of formation of clinopyroxenites, disthene- and coesite-bearing eclogites during the interaction of eclogites of different composition with hydrogen at high P-T parameters.

The existence of the native transitional metals requires the highly reducing conditions of environment. It was calculated, that at 40-60 kbars and 1000-1500°C the C-O-H-S fluid, that maintain stability of the diamond, FeS, native iron or tenite consists, mainly, of methane (40-90 mol.%) , water (5-30 mol.%) and hydrogen (up to 10-15 mol.%). Total content of the sulphur-maintained components (H_2S, CS_2, COS) is less than 1 mol.%.

Basing on analysis of results of the experimental studies and data on the natural diamonds, the four stages of diamond genesis were distinguished:
- diamond phase formation (diamond synthesis)
- growth of perfect monocrystals (recrystallization of diamonds)
- annealing of diamonds at the mantle P-T parameters after growth
- partial dissolution of the crystals in the Earth's mantle and during their moving to the surface.

In different natural processes some stages may be absent or repeated, and this stipulates so great differences of properties of the natural diamonds.