Geophysical Research Abstracts
Vol. 12, EGU2010-3981-1, 2010
EGU General Assembly 2010

Changes in the content and crystal morphology of diamonds from Paleozoic and Mesozoic kimberlits in the northeastern Yakutian kimberlite province

Anastasia Biller, Alexander Smelov, and Albert Zaitsev

Institute of Diamond and Precious Metals Geology, Siberian Branch, Russian Academy of Sciences, Yakutsk, Russia Federation.(a.p.smelov@diamond.ysn.ru)

The Yakutian kimberlite province combines more than 1000 kimberlite bodies. It is subdivided into two parts: southern and northeastern. The southern part contains highly diamondiferous kimberlite pipes of Middle Paleozoic age. In the northeastern part, weakly diamondiferous or barren kimberlite pipes of Paleozoic and Mesozoic age are found. The content of diamond-bearing pipes in the southern part is 27 %, and in the northeastern part – 0.06 %. The kimberlite pipes from the northeastern part are characterized by kimberlite- and Brazilian-type diamonds present in different proportions. We have made a statistical analyses of the content of morphologically different diamonds in these kimberlites with regard to their age. The most representative information was obtained for the kimberlite pipes Zapolyarnaya (360 Ma), Komsomol'skaya (382 Ma), Novinka (355 Ma), Leninrgad (380 Ma), Aerologicheskaya (409 Ma), Djanga (243 Ma), Malokuonapskaya (170 Ma), Grenada and Nadezhda (159 Ma) as well as for the Luchekan field kimberlites with an average age of 197 Ma.

Diamonds from the Paleozoic and Mesozoic kimberlites reveal a reverse relationship between the contents of octahedral and rounded crystals (r = - 0.969). Such relationship is characteristic of a single geologic body. The younger kimberlites contain higher amounts of Brazilian-type diamonds. In the age interval of 400-160 Ma, the average degree of diamond content in kimberlites decreases by about 85 %, and average weight of crystals by 55 %. More complex relationships are established in the systems: octahedral crystals – kimberlite age and rounded crystals – kimberlite age. The first system is characterized by a decrease in the amount of octahedra in the 400-250 Ma interval (r = 0.848,) and their increase in the interval from 250 to 160 Ma (r = - 0.901). Characteristic of the second system is the growing content of rounded diamonds in the interval 400-250 Ma (r = - 0.835) and their decline in the interval from 250 to 160 Ma (r = 0.897). In the system the ratio of laminar octahedra to rounded crystals – kimberlite age, the following relationships have been established: the ratio decreases from 3:1 to 1:1.5 (r = 0.907) in the 400-250 Ma interval, and increases from 1:2.5 to 4.5:1 in the 250-160 Ma interval (r = - 0.879).

Thus, the 400-250 Ma period was marked by dissolution of octahedral diamond crystals and formation of rounded diamonds in the mantle. This is supported by CL images of natural diamonds and experimental data. It was established in the experiments that dissolution of octahedral and cubic diamonds occurs in a water-bearing carbonate-silicate melt at P =50-55 Kbar and T =1350 – 1450oC. In the process of dissolution, primary octahedral crystals lose from 20 % (in a water-bearing melt) to 60% (in an anhydrous melt) their mass. This is supported by our empirical data indicating that the overall weight loss of diamonds throughout Paleozoic-Mesozoic is 55 %. Most intensely dissolved are diamonds from the Djanga kimberlite pipe aged at 243 Ma.

The character of morphologic changes of diamonds from Mesozoic kimberlites (250-160 Ma) suggests that generation of kimberlite magmas occurred in the heterogeneous mantle modified to varying degree. Modification of the mantle is likely to be due to the effect of a plume to which the formation of basic magmatic rocks aged at 250±5 Ma widely present in the Siberian platform is related. This assumption is also supported by isotopic data obtained for Mesozoic kimberlites of the Ary-Mastakh field, which have a common source with the Paleozoic kimberlites. It is likely that at that time changes took place in the mantle, which caused renewed growth of octahedral crystals as evidenced by overgrowths of octahedral diamond crystals on the Brazilian-type rounded diamonds. The average weight of the crystals and their content in the Mesozoic pipes do not grow.