

Mineralogical/crystallographic features of polycrystalline diamond, Yakutite

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Yakutite is a type of polycrystalline diamonds occurred from alluvial deposits in Northern Yakutia of Russia. It is characterized by a massive morphology and black color and appears to be similar to carbonado, another type of polycrystalline diamond. There are only a few previous studies on Yakutite and its origin (formation process and environment) and mineralogical/crystallographic characteristic have still remained unclear. In this study, I examined the microtexture of Yakutite samples by means of electron microscopy as well as x-ray diffractometry and Raman spectroscopy to understand what actually Yakutite is in material point of view. Raman spectra collected from Yakutite show a characteristic profile in which only a small and very wide diamond Raman peak at $\sim 1330 \text{ cm}^{-1}$ is observed together with a significant background increase toward the higher frequency side probably due to strong fluorescence signal from sample itself. The result suggests that the constituent diamond crystals in Yakutite are extremely small like the case of synthetic nano-polycrystalline diamond (NPD). The result of micro-focus XRD revealed the presence of varying degrees of lattice preferred orientation of diamond crystals and coexistence of lonsdaleite. Most samples show the co-axial relation between lonsdaleite 100 and diamond 111, suggesting that Yakutite is a product of direct conversion (martensitic transformation) from well-crystalline graphite. TEM observation showed that Yakutite consists of extremely small diamond grains of 5-50 nm which constructs weak lineation (layered-structure) along a particular direction. Electron diffraction also showed the coexistence of lonsdaleite with the co-axial relation to diamond (lonsdaleite 100 // diamond 111). Such a microtexture is well comparable to that of impact diamond from Popigai crater that is located at Northern West of Yakutia and produces a large amount of natural poly-crystalline diamond (Ohfuji et al., 2015). The distance between the locality of Yakutite and the Popigai crater is 350-500 km, which seems to be within the outreach of the long-distance ejecta from the crater. Therefore, Yakutite is an impact diamond that is originated from the large meteoritic impact at Popigai.

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