Phase composition of the contact surfaces of polycrystalline diamond and kimberlite

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Polycrystalline diamonds are commonly assumed to have precipitated during distinct diamond forming events, with the participation of fluids, at high levels of supersaturation and at high growth rates. They are often closely associated in time with the beginning of kimberlite magmatism. Polycrystalline zones contain large amounts of mineral and fluid micro-inclusions. Study of polycrystalline diamond contact with kimberlite rocks provides new information about the features of the phase composition of the crystallization medium.

The present work is concerned with a study of those contact zones separating polycrystalline diamond from kimberlite components. 8 kimberlite samples (from Rudenko collection, Udachnaya and Mir pipes, Yakutia) with contact layers and with fragments of polycrystalline diamond preserved in them were selected. Morphology and composition of contact layer surface were studied by SEM, without application of the diverter charge layer (CARL ZEISS LEO 1430 VP, equipped with an energy dispersive spectrometer). Identification of various phases was carried out by Raman spectroscopy using a micro-Raman spectrometer LabRAM HR800 (HORIBA Jobin-Yvon, 632.8 nm, He-Ne)). Analysis of the contact surfaces revealed the presence of various combinations of carbonate (Mg-calcite, dolomite), silicate (serpentine, forsterite) and sulphide phases. Content of amorphous and crystalline phases varied within wide limits. These mineral phases recorded in single grains of the polycrystalline diamond (with C above 80 at.%). In zones of the fibrillar diamond growth recorded an increased content of mineral phases. On the surface of contact is recorded the presence of carbon containing phases with varying content (within 40-80 at.%). On the surface of grains of polycrystalline diamond, as well as on the surface of imprints there is recorded a presence of nanostructured diamond-like phases (peaks in the frequency range 1324.6-1328.0 and 1576.3-1600.9 cm-1), the magnitude of which is proportional to the degree of disorder carbon containing phase and correlated with the share of sp3 bonds in non-diamond carbon.

The data obtained allow a better understanding of the features of polycrystalline diamond formation.