Phase composition of the contact surfaces of monocrystalline diamond and kimberlite

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A study of polymineral thin layer that separates diamond crystals from kimberlite rocks (in the literature it is called a rim, an imprint, a shell) can give some information on particular aspects of diamond genesis. Numerous experiments showed that metallic melts, in particular iron containing ones, form suitable media for synthesis of monocrystalline diamond. The theory of crystal growth implies that such melts act as diffusion boundary layers.

We study phase compositions of iron containing imprints of monocristals as possible rudiments of diamond growth system and compary them with the phase composition of a number of other imprints. 13 kimberlite samples with monocristal imprints were selected by magnetic separation as being magnetic because of the presence of iron containing phases and 7 non-magnetic samples were added for comparison (from Rudenko collection, Udachnaya and Mir pipes, Yakutia). Morphology and composition of contact layer surfaces 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 results showed the presence, in the iron containing imprints, of the following oxide phases: magnetite, maghemite, hematite, wustite; and also of such carbonate phases as siderite, Mg-calcite and dolomite. In nonmagnetic prints are also detected carbonate (calcite, Mg-calcite, dolomite), silicate (olivine, forsterite, serpentine, diopside, enstatite) and sulphide phases. Contents of amorphous and crystalline phases varied within wide limits. An essential result of the study of the morphology of the contact surfaces is the detection of corrugated fragments of iron containing imprints, which probably can be explained by the topochemical interaction of diamond surface, both with metallic iron and with iron oxides in various oxidation states.

The data obtained allow to consider the peculiarities of monocrystalline diamond formation in nature taking into account the role of thin layers of metal melts.