Micro-sized diamond-like phases at the contact of diamond crystals with kimberlite

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There are numerous experimental data on the conditions of diamond formation in the field of its thermodynamic metastability. It is also known that the "post-growth periods" contribute significantly to diversity of natural diamond crystals. Study of the structure and phase composition of contact areas of diamond crystals with host rock indicates the possibility of preservation of rudiments reflecting the conditions and composition of the parental system.

We studied micro-sized diamond, diamond-like, and carbon-bearing polycluster phases, the high concentration of which was registered in carbonate-silicate films at the contact of diamond crystals with kimberlite. The surfaces of diamond contact with kimberlite were studied in 34 samples (Mir and Udachnaya pipes, Yakutia; Rudenko collection). Morphology and composition of contact phases were investigated by the scanning electron microscopy (CARL ZEISS LEO 1430 VP) equipped with an energy-dispersive spectrometer. The chemical composition of the most abundant micro-sized phases and their distribution over the contact surface was analyzed on an electron microprobe. Raman spectra were obtained on a Micro-Raman RENISHAW (532 nm, 785 nm) spectrometer for better identification of the phases. The carbonate-silicate films of the contact are characterized by the high content of microdiamonds and diamond-like phases with different morphology: diamond-like overgrowths on diamond crystals, diamond relics of crushing with various degrees of crystallinity, partly structured phases, individual polycluster particles with a clear volumetric texture, amorphous phases with a strong dispersion, round aggregates, and "moustache". Raman spectra showed the presence of sp3 and sp2 hybridized carbon phases at various combinations of magnitudes at 1325-1600 cm-1. Raman spectra of diamond crystals at the contact zones reveals a shift of diamond peak which can be explained by mechanical stress.

The studied carbon phases, as well as carbonate-silicate phases of contact films on diamond crystals most likely participated in overgrowth and recrystallization of diamond crystals in the post-growth period during the interaction with evolving kimberlite melt by the cluster, rather than the atomic mechanism.