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The evolution of diamond morphology in the process of dissolution: Experimental data

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Abstract

In this paper, we report results of experiments on the dissolution of octahedral, pseudo-dodecahedral, and cubic natural diamond crystals in water-containing carbonate and silicate systems at high-pressure and high-temperature conditions in the diamond stability field. The dissolution agents used include $CaCO_3$, $CaMg(CO_3)_2$, $CaMgSi_2O_6$, and kimberlite from the Udachnaya pipe, Yakutia, with addition of distilled water. The obtained diamond dissolution forms were studied using scanning electron microscopy and double-beam interferometry. A quantitative analysis of rounded diamonds was carried out by the photogoniometry method. The experimental data show that diamonds change their morphology from octahedrons, dodecahedrons, and cubes to tetrahexahedroids when dissolved in water-containing systems. Octahedron transforms into tetrahexahedroid when the weight loss is 20–25%; cube, when the loss is >50%; and pseudo-dodecahedron passes into tetrahexahedroid when the weight loss is as low as 10%. Comparison of crystal morphology, surface features, and goniometric data of diamond dissolution forms produced in water-containing systems and of rounded natural diamonds showed their complete identity. It has been established that the morphological variations of rounded natural diamonds depend on the initial habit of the crystals and the degree of their dissolution. With the significant dissolution of the starting crystals the dissolution forms of initial octahedrons, pseudo-dodecahedron, and cubes are similar. The evolution of the diamond crystals morphology is terminated with the formation of tetrahexahedroid with curvature parameters AB = 36°07', CD = 13°15', and DD = 13°15'. The obtained quantitative data allowed us to construct a scheme for the morphological evolution of natural diamond crystals during their dissolution.

Keywords: Diamond, morphology, dissolution, HPHT experiment