A comparison of carbon isotope composition and impurity defects of microdiamonds of octahedral and cubic habit from Udachnaya kimberlite pipe (Yakutia)

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According to present concepts, growth forms for diamonds are an octahedron at the layer-by-layer mechanism and a cuboid at the adhesive one. Hence we have carried out a comparative study of microdiamonds of octahedral and cubic habit from Udachnaya kimberlite pipe.

As on our and previously published data [Kinny et al., 1999], isotopic composition of carbon for microdiamonds of octahedral habit from Udachnaya pipe is from -0,85 to -7,16 ‰ (δ^{13}_mean: -4,57 ‰; σ=1,54; n=18). Microdiamonds of cubic habit have a range of δ^{13}_ from -2,02 to -6,14 ‰ (δ^{13}_mean -4,46 ‰; σ=1,02; n=24).

Predominant nitrogen defects in microdiamonds of octahedral habit are IaA and IaB. The total nitrogen content in these crystals are mainly no more 350 ppm. At that about 50% of octahedra are nitrogen-free according to IR data (II_ type). The degree of nitrogen aggregation (IaB/IaA ratio) for octahedral crystals is more than 50%. Microdiamonds of cubic habit are characterized by presence of nitrogen only as IaA. The nitrogen content in cuboids (750-3000 ppm) is much higher than in studied octahedra. Complementary characteristic of all cuboids is the presence of hydrogen peaks in IR spectra.

On the diagram δ^{13}_/N [Cartigny et al., 2001] studied microdiamonds make up two non-overlapping fields. The upper field is formed by microdiamonds of cubic habit and lower – by octahedral microcrystals. The coincidence of carbon isotope composition of two different microdiamond populations suggests the absence of correlation of growth mechanism and isotopic composition of carbon for diamonds. Nevertheless obtained results reveal the influence of diamond growth mechanism on the content of nitrogen impurity. Adhesive growth mechanism favor to capture of impurities, whereas layer-by-layer one provide for growth of diamonds with low nitrogen content. Similar situation was previously described by us for "re-shaped" microdiamonds, where the change of growth mechanisms are found [Zedgenizov et al.].

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Characterization of Microscale Flow through Porous Media During Geologic Sequestration of CO_2

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We are developing a technique using Particle Image Velocimetry (PIV) to map microscale porous fluid flow. Our motivation is to understand the mixing of brine and CO_2 during aquifer sequestration of CO_2 and its impact on mineral-brine-CO_2 reactions. However, the dynamics of microscale fluid flow through pores and pore throats has applications to a variety of small-scale geochemical processes that take place in aquifers, soils, and other porous geological formations. For example, the pore-scale flow path through a heterogeneous rock or soil determines which minerals come into contact with fluid and the reactive surface area. Changes in flow velocity, such as at the mouth of a pore, may account for such phenomena as blocking of the downstream side of a pore throat by mineral precipitates.

PIV is a non-intrusive imaging technique for characterising multiphase flows. It requires an optically transparent test section, and refractive index matching of the test section and test fluid. The fluid is seeded with particles selected to have near neutral buoyancy and refractive index higher than that of the test section. The particles follow the flow and their path is imaged by periodic illumination by a sheet of laser light. The displacement of particles between illumination events is converted into velocity vectors.

We have constructed a clear plastic 2-D diagonal network model consisting of cylindrical pores, 2.5 mm across and 1.4 mm deep, connected by diagonal pore throats, 2.5 mm long across 1.4 mm deep. Pore throat widths vary randomly between 0.2 mm and 1.4 mm. NaI solution is seeded with 2 micron silicon carbide particles. This experimental design allows us to study the interface between 2 fluids at the scale of the test section and, using micro PIV, to map the fluid flow and interface within a single pore or pore throat.