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Chemical composition of nano-inclusions in supe-deep diamonds and implications to the growth condition

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Superdeep diamonds originating from the mantle transition zone and the lower mantle were found from alluvial deposits of Sao-Luis river (Juina, Brazil). We investigated carbon isotopic variations and chemical compositions of nano-inclusions in the superdeep diamonds which can give a clue for the growth condition.

The dominant inclusions in diamonds from studied here are CaSi-perovskite and AlSi-phases. MgSi- and CaTi-perovskites, ferropericlase, native iron, coesite and zircon have also been found. We found syngenetic inclusions of superdeep paragenesis from 59 diamond samples from Sao-Luis. Our SIMS analysis showed the wide variations of carbon isotopic compositions ranging from 2.7 to -25.3 ‰ in δ^{13}C.

Some samples contained microinclusions and FTIR analyses showed that water and carbonates are not major components of diamond-forming fluids. To identify the microinclusions, TEM observations were carried out on a foil of carbonado (0.1 micron thick) made from a polished diamond specimen after Au-coating. The foil was fabricated with a Ga ion beam using a focused ion beam (FIB) instrument (JEOL JEM-9310FIB). The foil was observed with a TEM (JEOL JEM-2010) under an accelerating voltage of 200 kV. We first found out euhedral inclusions of several tens nanometers in size. At present, the chemical composition or mineral species of these nano-inclusions are not clarified.Nanometer-sized inclusions were found in sevearal samples. TEM observation revealed that the nano-inclusions have a negative cystal shape suggesting the syngenetic origin directly related to the diamond growth. Chemical composition obtained from synchrotron X-ray fluoresncence analysis clarified that the nano-inclusions contain S, Cr, Mn, Fe, Co, Ni, Cu Zn, and so on. The present study suggests that the growth media of the superdeep diamonds are composed of sufilde melt.
Keywords: diamond, nano inclusion, X-ray fluorescence analysis, super deep diamonds