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Deep carbon and growth environment of superdeep diamonds from Sao Luiz, Brazil

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Diamonds are one of the natural samples providing us with direct information on materials in the deep earth. Some of diamonds from Sao Luiz, Brazil, are known to originate from the transition zone and lower mantle from the existence of ferropericlase and back-transformed magnesium perovskite as inclusions.

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. Raman shift of coesite show high residual pressure (>3 GPa). CL image has revealed the complex growth history for most diamonds, reflecting their formation in several stages. The total range of carbon isotope composition in diamonds studied by SIMS makes up from -3.3 to -20.3 per mil of delta^{13}C. Some diamonds show local variations of delta^{13}C between different growth zones (up to 7 per mil).

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 to several hundreds nanometers in size. At present, the chemical composition or mineral species of these nano-inclusions are not clarified. However, the presence of these nano-inclusions will be a key to understand the growth process.

Based on these microscopic observations coupled with carbon isotopic distribution obtained from SIMS measurements, deep carbon cycle inferred from the growth history of the super-deep diamonds will be discussed.

Keywords: diamond, lower mantle, carbon cycle, inclusions