Origin of natural polycrystalline diamond (carbonado) inferred from the inclusions in the diamond crystals

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Carbonado is a natural polycrystalline diamond consisting of submicron or several micrometer diamond grains. While many natural diamonds are found in kimberlite, carbonado is mined from only alluvial deposits in the Central African Republic and Brazil. Since carbonado contains no information about its host rock, the origin of carbonado is still in a mystery. In previous studies, several assumptions on the genesis of carbonado have been proposed: metamorphism caused by a large impact on the Earth's crust, transformation of organic sedimentary carbon into diamond at high pressure, and radiation-induced diamond formation from organic carbon; but none of these are conclusive. Recently, a couple of studies on infrared (IR) absorption spectra of carbonado were reported. Kagi and Fukura (2008) suggested that carbonates and fluid inclusions were contained in carbonado, but they did not conclude clearly that the inclusions existed in grain boundary or in diamond crystals. In this study, we found the evidence of primitive inclusions in the diamond crystals. From the inclusions in the diamond crystals, we will discuss the origin of carbonado.

Carbonado samples were from alluvial deposits in the Central African Republic. Before measuring IR spectra, crushed carbonado was heated in vacuum and hydrous components in the grain boundaries were removed. Before heating, a peak assigned to hydrogen bonded Si-OH was observed in the area of 3000-4000 cm-1. After heating, this peak became weak and another peak assigned to molecular water became predominant. The latter peak assignable to molecular water was hidden by the Si-OH peak and was slightly observed before heating. These results suggest that hydrous minerals in grain boundary were dehydrated by heating and fluid inclusions trapped in diamond crystals remained even after heating. In addition, a peak assigned to carbonate was also observed in all measurements. These results strongly suggested that C-O-H fluids were involved in the stage of crystallization of carbonado in the upper mantle.

Moreover, experimental results on micro-Raman spectroscopic analysis and FIB-TEM observations will be reported in the presentation.