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Deep carbon reservoir inferred from natural polycrystalline diamonds, carbonado

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Carbonado is a natural polycrystalline diamond aggregate and the characteristics are very different from those of typical mantle-originated diamonds. The carbon isotopic compositions is significantly depleted in C-13 and no mantle-originated mineral inclusions have been found. Moreover, fluencies form radioactive nuclides were found from radiation damage and fissionogenic noble gasses. Based on those observations, some of researchers proposed crustal origin of carbonado diamond, which suggested diamond formation from biogenic carbon under a thermodynamically metastable condition with high-energy particles. On the other hand, residual pressures as high as 1GPa were detected inside of carbonado diamonds and the mantle-origin is also remained as a potential origin.

We recently carried out TEM observations on FIB-fabricated carbonado samples. The obtained fine structure showed that fluid inclusions as primary origin were trapped within a grain of diamond. The experimental results strongly suggests that the carbonado grew under the presence of fluids at a P-T condition where diamond is thermodynamically stable. Given that carbonado is originated from the mantle, this suggests that there may be a large carbon reservoir depleted in C-13 in the mantle or C-13 depletion occurred during the formation process of carbonado diamonds. In the presentation, we will discuss the relation between carbon reservoir in the mantle and the origin of carbonado based on our recent spectroscopic, isotopic and TEM observations.

Keywords: diamond, carbonado, mantle, carbon isotope