

Mantle process inferred from Os isotopic ratios and micro-inclusions in carbonado diamonds

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Carbonado, a type of natural polycrystalline diamond, has characteristics distinct from those of typical natural diamonds originated from the earth's mantle: for example, no genetic relations to kimberlites, very low carbon isotopic ratios, and the lack of mantle-derived mineral inclusions, and so on. Based on these characteristics, several diverse hypotheses have been proposed on the origin of carbonado, and the origin has been enigmatic. At present, no conclusive evidence has been proposed to settle the controversy. The most important point we have to remind is that carbonado had been heavily altered after the crystallization of diamonds and the grain boundaries of micro-diamonds in carbonado may have lost the intrinsic information on the formation of diamonds consisting of carbonado.

In this study, we tried to extract isotopic and mineralogical information from inside of carbonado diamond grains and grain boundaries, independently. We thought that the original information related to diamond crystallization was retained inside of diamond crystals and traces of the secondary process after the diamond formation was located in the grain boundaries of diamonds.

We conducted Os isotopic analysis and electron microscopic observation on carbonado samples collected from placer deposits in the Central African Republic. The Os isotopic ratios ($^{187}\text{Os}/^{188}\text{Os}$) obtained from inside of diamond grains was notably lower than that from the grain boundaries. This suggests that the grain boundaries were altered with crustal materials. Moreover, mantle-originated microinclusions were found inside of diamond grains.

The origin of carbonado will be discussed based on the intrinsic information obtained from the inside of diamond grains. The obtained results strongly suggest the mantle-origin of carbonado and secondary alteration in the crust.