Mantle origin of natural polycrystalline diamond, carbonado, inferred from inclusion chemistry

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Carbonado is a kind of natural polycrystalline diamond having characteristics such as low $\delta^{13}C$ values, high porosity, no occurrence in kimberlite pipe, lack of mantle-derived mineral inclusions, detection of fission-genic isotopes, and so on. From these characteristics distinct from those of typical mantle–derived diamonds, several hypotheses such as impact-induced diamond formation from organic carbon (Smith and Dawson, 1985), irradiation-induced phase transformation from coal (Ozima et al., 1991), chemical vapor deposition in interstellar space (Garai et al., 2006) and supernova (Haggerty, 2014) have been proposed. Besides these hypotheses, mantle-origin of carbonado has been also proposed (Robinson, 1978; Kagi et al., 1994; Nadolinny et al., 2003; Ishibashi et al., 2012). At present, the origin of carbonado is still controversial and no conclusive evidence has been proposed to settle the discrepancy.

It should be noted that carbonado had been heavily altered after the crystallization of diamonds and the grain boundaries of micro-diamonds in carbonado can have lost the intrinsic information on the formation of diamonds. Many of studies reported previously may be affected by the secondary after the diamond formation. It is highly possible that the original information related to diamond formation is retained inside of diamond crystals. The purpose of this study is to extract information on diamond crystallization of carbonado

In this study, we tried to distinguish isotopic and mineralogical information between inside of carbonado diamond grains and grain boundaries. 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 ($^{187}Os/^{188}Os$) 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 microincluions were found inside of diamond grains. From these information, we will discuss the deep origin of carbonado diamonds.