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FE-SEM-EBSD analyses on texture of natural polycrystalline diamonds, carbonado

Hidemi Ishibashi[1*], Haruko Sakurai[1], Hiroyuki Kagi[1], Hiroaki Ohfuji[2]

[1]Geochem.Lab.Univ.Tokyo, [2]GRC. Ehime Univ.

Carbonados are a type of natural polycrystalline diamonds. They have characteristics such as high porosity, low 13C/12C isotope ratio, radiation effects from radioactive nuclides, and lack of representative mantle mineral inclusion, which enable us to discriminate them from other mantle-derived diamonds. Furthermore, they were found only from alluvial placers and there is no evidence for association with kimberlite and related magmas. These characteristics made researchers to propose several hypotheses for genesis of carbonados other than crystallization/ transformation under mantle P-T conditions (e.g., metamorphism caused by a large impact on Earth's crust, radiation-induced formation in organic carbon, and crystallization in a hydrogen-rich interstellar space environment); their genesis is still controversial. The aim of this study is to extract information about the formation processes of carbonados from their textural features.
In this study, we analyzed two carbonado samples from the Central Africa Republic (CAR). FE-SEM with EBSD analytical system at Geodynamics Research Center, Ehime University, was used to observe submicron-scale textural features and quantify distributions of crystal size and crystallographic orientation. The two samples show markedly distinct textural features. One is similar to granular texture characterized by relatively planar grain boundaries and low porosity. The other is uncommon texture characterized by zigzag grain boundaries and high porosity with polygonal pores. No evidence of lattice preferred orientation was found in both samples. Both of the samples reveal similar crystal size distribution for grain diameter, D, larger than ca. 2 microns. In the size region, negative linear relation with an inflection point at ca. 10 microns was observed between the log number density and log D with slopes of ca. -2.7 and -4.5 for D smaller and larger than ca. 10 microns, respectively. The former sample is depleted in submicron crystals whereas the number density increases as D decreases for the latter sample. EBSD analyses proved that the zigzag shape of grain boundary in the latter sample is controlled by {111} facets of diamond. Based on these descriptions, we will discuss on the formation processes of the two types of the textures and the genesis of carbonados.

Keywords: carbonado, EBSD, texture, diamond, CSD, polycrystal