The 492nd Geodynamics Seminar

Understanding the origin of carbonado, an enigmatic polycrystalline diamond, through analysis of primary nano-inclusions

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Abstract

Carbonado is a type of polycrystalline diamond, which shows a grayish to black color and a massive and irregular morphology with a porous internal texture. It is distinct from ordinary mantle-derived diamonds in the following respects: extremely low carbon isotope composition (-25~-30 ‰), absence of mantle-derived primary inclusions, high concentration of radiogenic noble gases, etc. Therefore, the origin of carbonado has long been controversial. A recent study (Ishibashi et al., 2010) found several lines of evidence that H2O-rich fluid is present within constituent diamond grains of carbonado, suggesting its formation in close association with C-H-O fluid in the Earth's mantle. However, the detail of the formation process and condition of carbonado is still unclear.

Here, we found primary mineral inclusions (majoritic garnets, phengite, rutile, apatite, etc.) in nano-sized negative crystals within diamond grains by detailed FE-SEM and TEM observations. Those precipitates usually occur as an assemblage of a few to several mineral phases that are mostly in euhedral forms in the negative crystals. They are most likely quenched products from silicic fluid that were trapped during the crystal growth of diamonds that comprise carbonado. The presence of these mineral phases in negative crystals suggests that the formation of carbonado occurred in fluid-saturated environments to which crustal materials (e.g. basalt) are supplied potentially by the subduction of oceanic plates or extensive collision of continental plates to form a thick mantle keel.

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