衝突ダイヤモンドの微細組織の結晶化プロセス
Microtexture and crystallization process of impact diamonds

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Impact diamonds from the Popigai crater located in the central Siberia, Russia show unique nano-polycrystalline texture composed of diamond and a small amount of lonsdaleite of ~50 nm (Ohfuji et al., 2015), which is well comparable to the nano-polycrystalline diamond synthesized by direct conversion of graphite under high pressure and high temperature (Irifune et al., 2003). However, subsequent studies noted that they show a variety of microtexture such as lamellar or layer textures and granular textures. In the present study, we investigated the mineralogical and crystallographic characteristics of the various microtextures shown by the Popigai diamonds by TEM.

The microtextures found in Popigai diamonds are divided into two types, 1) lamellar type and 2) granular type. The former is further classified into two types, 1a) less-mosaiced lamellar and 1b) mosaiced lamellar. The latter can also be divided further into 2a) granular texture composed of fine crystals of <50 nm and 2b) granular texture composed of larger (~100 nm) crystals. Careful textural observations and electron diffraction analysis revealed that the microtextures of Popigai diamonds vary from layered texture to granular texture (1a →1b →2a →2b) as the phase transitions from graphite to lonsdaleite to diamond proceed. The phase transition mechanism also changes from martensitic process involving a lattice relationship (Graphite (001) // Lonsdaleite (100) // Diamond (111)) to diffusion process where the nucleation of new grains and the their growth are promoted.

The most important factor controlling the degree of the phase transitions and the resulting microtexture is probably the shock temperature, which is supposed to have decreased gradually from the center to rim in the crater.

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