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Enigmatic alternations of carbon and SiO_2 polymorphs within the kyanite porphyroblasts from the Kokchetav diamond-bearing kyanite gneisses

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High concentrations of carbon polymorphs (graphite and diamond) are documented in porphyroblast (garnet and kyanite) from different ultrahigh pressure lithologies (Kokchetav massif, Northern Kazakhstan). Only kyanite porphyroblasts have characteristic distribution of carbon polymorphs – graphite- and quartz-rich core and diamond-rich rim zone. Grain sizes of graphite crystals decrease from core to rim of some kyanite porphyroblasts. In addition to graphite and quartz, garnets are abundant inclusions in the core of the kyanite porphyroblasts and were identified by optical microscopy. The sizes of garnet crystals increase from core to rim indicating the contemporary growth of kyanite and garnet. Interestingly that while kyanite crystals contain abundant graphite inclusions, mainly diamond occur as inclusions in small garnet crystals, which on its turn included in graphite-rich zone of kyanite. Raman spectroscopic study of SiO_2 inclusions reveals that some of these inclusions are coesites. The upshift of main Raman band of coesite up to 524 cm-1 indicates relatively high residual pressure for coesite inclusions. Neighboring monocrystalline quartz inclusions display no significant upshit of main quartz bands, showing very low (close to detection limit) residual pressures. The presence of both carbon polymorphs within the same growth zone of kyanite porphyroblasts indicate that variations of some intensive parameters like pressure, temperature or fluid/melt compositions were extremely localized (less 1 mm3). The local variations of temperature is unlikely, therefore the variation of pressure or compositions of fluid or melt was most important parameters in diamond or graphite origin. Coexistence of coesite and monocrystalline quartz can be explained assuming that transformation coesite-to-quartz also controlled by local peculiarities (e.g. mechanical properties or H_2O contents). The preservation of such small-scale heterogeneities in the presence of fluid or melt indicates extremely high speed of exhumation at least during first stage. All our data indicates that crystallization of diamond and graphite proceeds in the same P-T conditions. An operating of simultaneous dissolution-precipitation processes accelerates the transformation of original carbonaceous material into graphite or diamond in the presence of fluid or melts.
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