Optically invisible disordered graphite in coesite inclusions in kyanite from diamondiferous Kokchetav gneiss

SHCHEPETOVA O. V.[1,2], KORSAKOV A. V.[1], MIKHAILENKO D.S.[1], ZELENOVSKY P. S.[3]

[1] Novosibirsk State University, Novosibirsk, Russia
[2] V.S. Sobolev Institute of Geology and Mineralogy SB RAS, Novosibirsk, Russia
[3] Institute of Natural Sciences, Ural Federal University, Ekaterinburg, Russian Federation

Petrological investigations are crucial for understanding mineral relations. Residual UHP minerals, such as diamond and coesite, are very small and Raman spectroscopy is required for their reliable identification. In this study 3D Raman imaging is applied to coesite inclusions from diamondiferous kyanite gneiss of the Barchi-Kol terrane (Kokchetav Massif). The Kokchetav gneiss consists of large kyanite and garnet porphyroblasts embedded in a quartz-biotite-phengite-K-feldspar matrix, with rutile, graphite, zircon, monazite, apatite, diamond and coesite accesories. Kyanite porphyroblasts show zoned distribution of C and SiO_2 polymorphs: (i) Gr-rich core, with Q and Coe inclusions and rare Dia crystals, and (ii) clean overgrowth zone with Dia cuboctahedral crystals. High-resolution 3D Raman imaging of coesite inclusions with optically undetectable disordered graphite by an *alpha-WITec Raman* system equipped with a 488 nm laser and a 100X NA0.9 objective has revealed no diamond or traces of fluid inclusions. The residual pressures for quartz and coesite are ~1 GPa. The association of coesite and disordered graphite is forbidden in UHP rocks. Disordered graphite may crystallize from COH-fluid entrapped by coesite close to the peak of metamorphic conditions. The fluid accelerates the Coe→Q transition, and the ensuing dramatic expansion can lead to cracking of the host mineral and precipitation of disordered graphite during exhumation. Thus, (i) geothermometers based on graphite crystallinity can be hardly used for UHP rocks and (ii) the presence of disordered graphite is not neccesarily related to partial diamond graphitization.

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