[EJ] Evening Poster | S (Solid Earth Sciences) | S-MP Mineralogy & Petrology

[S-MP37]Deformed rocks, Metamorphic rocks and Tectonics

convener:Yoshihiro Nakamura(Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology), Yumiko Harigane(Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology (AIST))

Mon. May 21, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)

We invite all researchers who aim to understand the dynamics of the earth's crust and mantle at the plate boundaries, to discuss the latest results from various viewpoints. The scope will include contributions through petrology and structural geology as well as various techniques including rheology and transformation of heat and mass.

[SMP37-P09]Factors controlling the coesite–quartz transformation in UHP eclogite: Effects of dislocations in kyanite

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Keywords:coesite, kyanite, dislocation, UHP eclogite, FIB-TEM

Coesite is a key index mineral used to define ultrahigh-pressure (UHP) metamorphism. It generally occurs as inclusions in mechanically strong phases such as garnet and zircon (e.g., Parkinson &Katayama, 1999). However, host minerals develop radial cracks as a result of coesite being transformed into polycrystalline quartz (pseudomorphs). The amount of retrogression from coesite to quartz is typically unequal for each sample (Hacker &Peacock, 1994). It is possible that the presence of aqueous fluids at the inclusion–host mineral boundary and/or the exhumation rate of UHP rocks promote the transformation of coesite (e.g., Mosenfelder et al. 2005). Hence, the pseudomorphs could be useful for understanding the exhumation process of UHP rocks and the behavior of metamorphic fluids. In general, the progress of the transformation is affected by anisotropic stress within the crystal and the presence of defects like dislocations. However, little work has been done on nanotextural analyses of natural coesite and its host mineral. In this study, we carefully examined coesite and its pseudomorphs in UHP eclogites from eastern China and confirmed that relict coesite in kyanite had not transformed completely into quartz. Using Raman spectroscopy and the FIB-TEM technique, we described the micro- to nano-textural characteristics of the coesite and host kyanite.

The sample was taken from the Su-Lu terrane, Junan, Yangzhuang region, eastern China. Peak pressure and temperature conditions of 660–725 °C and 3.1 GPa were estimated by conventional geothermobarometry (Taguchi et al. 2016). Relict coesite inclusions were identified in (1) kyanite from garnet and (2) matrix kyanite. The results of the study were as follows. (1) Coesite inclusion in kyanite from garnet crystal: The presence of polycrystalline quartz grains and radial cracks in the host kyanite was not confirmed. Coesite under anisotropic stress was confirmed within the crystal and retained a maximum residual pressure of about 0.35 GPa. Our TEM observations also did not confirm quartz grains at coesite inclusion–host mineral boundaries. Dislocations were not confirmed in coesite, but many dislocations and sub-grain boundaries were developed in kyanite. The estimated dislocation density in kyanite was ≈10^8 cm^{-2}, but the dislocation density adjacent to coesite inclusion–host kyanite boundaries was ≈10^9 cm^{-2}. The high dislocation density region was located adjacent to a low residual pressure area of coesite. (2) Coesite inclusion in matrix kyanite: Microcracks were confirmed in host kyanite adjacent to the coesite inclusion, but polycrystalline quartz grains were not

observed. Coesite exposed on the surface of the thin section showed released residual pressures. As is the case of (1), TEM observations did not confirm quartz grains at the mineral boundaries. Dislocations were also not observed in coesite, but many dislocations and stacking faults were developed in kyanite. The estimated overall dislocation density in kyanite was ≈10^{8} cm^{-2}, but a high dislocation density region (≈10^{9} cm^{-2}) was also present.
Menard et al. (1977) and Kerrick (1986) reported that the dislocation density in natural kyanite is $<10^{8}$ cm^{-2}. This study showed that dislocation densities of kyanite with coesite are at least an order of magnitude higher than those reported for natural kyanite. The presence of anisotropic stress within the coesite might be affected by dislocations and sub-grain boundaries in the kyanite. Dislocation density is generally reduced during annealing processes, but our results revealed that all dislocations in kyanite had not uniformly recovered during the exhumation of the UHP rocks. This fact suggests that dislocations are one of the factors controlling the coesite–quartz transformation. In addition, we showed that kyanite can sufficiently act as a pressure vessel, even in the case of UHP metamorphism.