

Amorphous SiO₂ phase in a pseudomorph after coesite in garnet of a Su-Lu ultrahigh-pressure eclogite

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Coesite has been identified in continental collision-related metamorphic rocks and serves as a critical indicator of ultrahigh-pressure (UHP) metamorphism. Coesite grains and their pseudomorphs effectively preserve geological and mineralogical information, which is useful for understanding the exhumation process of UHP belts. Although the pseudomorphs after coesite included in robust phases are generally composed of polycrystalline α -quartz grains, occurrences of K-feldspar in these pseudomorphs have also been reported. The mineralogical data of polyphase pseudomorphs are insufficient, and their origins are not well understood.

By using a Focused Ion Beam (FIB) system, Transmission Electron Microscopy (TEM), and Raman spectroscopy, pseudomorphs after coesite in a garnet of a Sulu UHP eclogite obtained from Yangzhuang, Junan region, eastern China, were carefully examined in this study. Anomalous pseudomorphs consisting of amorphous SiO₂ (APSI) and K-bearing fibrous phases were noted; the existence of an APSI phase in UHP rocks has not been reported previously. In this presentation, we report on the crystal chemical features and nano-textural characteristics of the pseudomorph.

The eclogite sample includes garnet porphyroblasts mostly 1 mm in diameter or larger. These garnet grains are composed of inner and outer segments with the boundary marked by discontinuous changes in the grossular content. The pseudomorphs occur within only the outer segment of the host garnet, and radial cracks have developed in the garnet around them. These pseudomorphs are divided into darkly colored and transparent areas under plane-polarized light, which are dominant mainly at the core and in the marginal parts, respectively. The transparent area is composed of fine-grained α -quartz crystals. The darkly colored area consists of fine-grained aggregates of an SiO₂ phase and a fibrous phase including K and Mg. The Raman spectra of the SiO₂ phase in the darkly colored area do not show definitive Raman bands. The fibrous phase has a broad Raman spectrum and does not show a distinctive Raman band. The TEM observation of a cross-section of the pseudomorph shows that the internal structure consists of a worm-like SiO₂ phase and fibrous parts. The selected area electron diffraction (SAED) analyses of most parts of the worm-like SiO₂ phase did not show diffraction spots, suggesting a non-crystalline state. In addition, the SAED analysis of fibrous minerals shows weak ring patterns with corresponding d-values of approximately 4.8, 4.3, and 2.5 Å. According to these d-values and Energy Dispersive X-ray Spectrometry (EDS) analysis data, the fibrous minerals were identified as polycrystalline sheet-silicates (KFSS). This study also discusses the origin of the pseudomorph consisting of APSI and KFSS phases and implications on the behavior of metamorphic fluid during the retrograde stage

Keywords: Pseudomorph after coesite, Amorphous SiO₂ phase, Su-Lu UHP eclogite, TEM observation