Temperature dependence of water solubility in coesite at 5 GPa

WEI YAN[1,2], XI LIU[1,2], YANYAO ZHANG[1,2], MINGYUE HE[3], SAIJUN SUN[4], WEIDONG SUN[4]

[1] School of Earth and Space Sciences, Peking University, Beijing 100871, China (wei.yan@pku.edu.cn)
[2] Key Laboratory of Orogenic Belts and Crustal Evolution, Ministry of Education of China, Beijing 100871, China
[3] School of Gemmology, China University of Geosciences (Beijing), Beijing 100083, China
[4] Center of Deep Sea Research, Institute of Oceanography, Chinese Academy of Sciences, Qingdao 266071, China

Coesite is a key index mineral used to define the ultra-high pressure metamorphism and its discovery provides compelling evidence for the burial of crustal rocks to mantle depths > 100–120 km. Unfortunately, in many cases coesite did not survive exhumation process but transformed back to quartz. One critical factor affecting its preservation is the H content. Currently a general consensus has been reached about the positive correlation between the water solubility and pressure [1]; by contrast, a good agreement on the correlation between the water solubility and temperature is still in disputes [2, 3].

In this study, we carried out 16 high-P experiments at 5 GPa and 800–1600 °C. All the experimental products contained coesite crystals with grain sizes up to ~500 μm, and those at high T were melt-bearing. The coesite and melt were identified and characterized by Raman spectroscopy. Using unpolairzed FTIR spectroscopy, we determined the water contents of coesite synthesized at different T, and explored the H incorporation mechanisms. We have found that the water solubility increases first with T at $T < 1400$ °C, and then decreases with T at higher T. We have also found different water incorporation mechanisms at high and low T. In addition, we successfully conducted LA-ICP-MS analyses on coexisting coesite and melt, and determined the partition coefficients of 36 trace elements for the first time.

With our experimentally-determined correlation of the water solubility of coesite and T, the water solubility in the coesite around the coesite/quartz phase transition pressure at typical T conditions in the subduction zone will be deduced and its role in the coesite preservation will be discussed.

[1] Mosenfelder (2000) *Phys Chem Minerals* **27**, 610–617. [2] Koch-Müller et al. (2003) *Am Mineral* **88**, 1436–1445. [3] Deon et al. (2009) *Eur J Mineral* **21**, 9–16.