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### Venue: Meeting Room #486

Science Research Bldg. 1, 4th floor.

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#### Keywords:

1. Water transport
2. Nominally anhydrous minerals
3. Davemaoite

## In situ lattice volume observation of davemaoite in a water-saturated system up to uppermost lower mantle conditions

The water solubility of davemaoite ( $\text{CaSiO}_3$  perovskite, hereafter denoted as Dm), a major mineral in the lower mantle, is important for an accurate understanding of the distribution and transportation of water in the lower mantle. Recently, some studies reported that the lattice volume shrinks by incorporating water in Dm based on laser-heated diamond anvil cell experiments and theoretical calculation (Chen et al., 2020; Shim et al., 2022), and proposed that solubility of water in Dm as high as 0.5-2 wt.%. However, the relationship between water content and lattice volume change is not established due to the paucity of experimental data, and thus, the actual value of water solubility in Dm is still unclear. In this study, we investigated change of the lattice volume of Dm in a water-saturated system under high pressure-temperature conditions

In situ X-ray observation were performed at pressure of 10-32 GPa and temperatures up to 1900 K using a multi-anvil apparatus, SPEED-MkII at BL04B1 in SPring-8. Starting materials are natural mineral suolunite ( $\text{Ca}_2\text{Si}_2\text{O}_5(\text{OH})_2 \cdot \text{H}_2\text{O}$  with a water content of ~14 wt.%) and wollastonite (heated suolunite at 1000°C) mixed with a gold powder. X-ray diffraction (XRD) patterns of the sample and gold pressure marker were obtained by an energy-dispersive system under high-pressure and high-temperature. The sample was oscillated during the diffraction measurements to obtain well averaged XRD patterns even after significant grain-growth. We referred to Sueda's PhD thesis, (2005) as the equation of state for anhydrous Dm for comparison, and evaluated the error by the bootstrap method.

In the hydrous system, unidentified peaks originating from the unknown hydrous phase were observed at <17 GPa and <1000°C. The lattice volume of Dm at ~15 GPa is nearly equal to that calculated from the EOS of anhydrous Dm throughout heating up to 1573 K. In contrast, at ~20-28 GPa, we observed volume expansion (excess volume) only immediately after crystallization at ~873 K. This excess volume decreased with increasing temperature and time, indicating that metastable  $\text{Si}^{4+} \leftrightarrow 4\text{H}^+$  substitution may occur. Above 20 GPa, the reduced lattice volume was apparently smaller (-0.2~-0.7%) than the lattice volume of anhydrous Dm. However, this is within the range of variation of the lattice volume of Dm observed in anhydrous experiments. Thus, we consider that the volume shrinkage of Dm is not occurring. In addition, no significant amount of water content was detected in a recovered sample using secondary ion mass spectrometry (SIMS). All these observations did not give any positive evidence of water dissolution in Dm at high pressure and high temperature.