

## **Thermal equation of state of CaGeO<sub>3</sub> perovskite**

**WEI LIU,<sup>1,\*</sup> JENNIFER KUNG,<sup>2</sup> LIPING WANG,<sup>1</sup> AND BAOSHENG LI<sup>1</sup>**

<sup>1</sup>Mineral Physics Institute, Stony Brook University, Stony Brook, New York 11794, U.S.A.

<sup>2</sup>Department of Earth Sciences, National Cheng-Kung University, Tainan 70101, Taiwan

### **ABSTRACT**

Pressure-volume-temperature data have been obtained for CaGeO<sub>3</sub> perovskite up to 9.6 GPa and 1100 K using a cubic anvil, DIA-type high-pressure apparatus in conjunction with synchrotron X-ray diffraction. The data were analyzed using Birch-Murnaghan equation of state and thermal pressure approach with the bulk modulus at ambient pressure,  $K_{T_0}$ , and its pressure derivative,  $K'_{T_0}$ , constrained by previous measurements. A fit of the unit-cell volume data to the high-temperature Birch-Murnaghan (HTBM) equation of state gives  $(\partial K_T/\partial T)_P = -0.025 \pm 0.015$  GPa/K,  $a = 1.047 \pm 0.356 \times 10^{-5}$ /K, and  $b = 3.282 \pm 0.735 \times 10^{-8}$ /K<sup>2</sup> for the thermal expansion  $\alpha$  expressed by  $a + bT$ . The thermal pressure approach yields  $\alpha K_T = 4.04 \pm 0.37 \times 10^{-3}$  GPa/K and  $(\partial^2 P/\partial T^2)_V = 6.17 \pm 1.28 \times 10^{-6}$  GPa/K<sup>2</sup>. The energy dispersive X-ray diffraction data reveal no indication of a structural phase transition over the  $P$ - $T$  range of the current experiment. A systematic relationship,  $K_{S_0} = 6720/V(\text{molar}) - 13.07$  GPa, has been established based on these isostructural analogues, which predicts  $K_{S_0} = 261(15)$  for MgSiO<sub>3</sub> perovskite and 225(8) for CaSiO<sub>3</sub> perovskite, respectively.

**Keywords:** CaGeO<sub>3</sub> perovskite, equation of state, thermal pressure, high pressure and high temperature, X-ray diffraction