Temperature-pressure-volume equation of state of (Mg,Fe)2SiO4 ringwoodite

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We present a temperature-pressure-volume (T-P-V) equation-of-state (EOS) of (Mg0.8,Fe0.2)2SiO4 ringwoodite based on in situ high-T and high-P synchrotron X-ray diffraction experiments up to 1700 K and 20 GPa with a multi-anvil apparatus at SPring-8. The third-order Birch-Murnaghan equation was applied to the data between 300 and 900 K, while a constant thermal-pressure fitting at temperatures higher than 900 K. By fixing previously measured volume thermal expansivities at 0 GPa and the isothermal bulk modulus at 300 K and 0 GPa, we derived the T-P-V EOS parameters of (Mg0.8,Fe0.2)2SiO4 ringwoodite using least squares. At P = 20 GPa and T = 1800 K, as representative conditions in the lower part of the mantle transition zone, the relative V and KT values of (Mg0.8,Fe0.2)2SiO4 ringwoodite with respect to the values at 300 K and 0 GPa are found to be V/V0 = 0.9424, KT/K0 = 1.263, based on the present EOS. About 10 % Fe is thought to substitute for Mg in the mantle. The present V/V0 and KT/K0 results for (Mg0.8,Fe0.2)2SiO4 ringwoodite, combined with the corresponding data for Mg2SiO4 ringwoodite, describe that the effects of the Fe substitution for Mg of (Mg0.9,Fe0.1)2SiO4 ringwoodite in the mantle transition zone are virtually negligible on V/V0, and less than 1% on KT/K0.