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Determination of postspinel phase boundaries in Mg2SiO4 and (Mg0.9,Fe0.1)2SiO4 by in situ X-ray diffraction experiments

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We investigated postspinel phase boundaries in Mg2SiO4 and (Mg0.9,Fe0.1)2SiO4 between temperatures of 1673 and 2173 K by in-situ X-ray diffraction measurements at SPring-8. We did not observe effect of ferrous iron to the postspinel phase boundary, and they are expressed as P (GPa) = 26.42 - 0.0022 T (K). The determined Clapeyron slope of -2.2 MPa/K is reasonably consistent with those determined by thermodynamic calculation (Akaogi et al., 2007) and first principles investigation (Yu et al., 2007), whereas it is inconsistent with recent experimental works which reported that the transition pressures are insensitive to temperature (Katsura et al., 2003; Fei et al., 2004). The postspinel transition pressure at 1873 K is calculated to be 22.4 GPa, which is about 1 GPa lower than that at 660 km depth, indicating effect of aluminum in pyrolitic composition to the transition pressure or uncertainty of MgO pressure scale. We can interpret topography of 660 km seismic discontinuity (plus-minus 20 km from the average) as temperature anomaly of plus-minus 370 K using the postspinel Clapeyron slope determined in the present study. The postspinel Clapeyron slope of -2.2 MPa/K can produce buoyancy for subducting slabs and the buoyancy is one of the main factors to let them stagnant on the 660-km discontinuity.

Keywords: postspinel, phase boundary, Clapeyron slope, 660 km seismic discontinuity