Density of dry peridotite magma at high pressure using an X-ray absorption method

TATSUYA SAKAMAKI,[1,*] EIJI OHTANI,[1] SATORU URAKAWA,[2] AKIO SUZUKI,[1]
AND YOSHINORI KATAYAMA[3]

[1]Department of Earth and Planetary Materials Science, Tohoku University, Sendai 980-8578, Japan
[2]Department of Earth Sciences, Okayama University, Okayama 700-8530, Japan
[3]Japan Atomic Energy Agency, Hyogo 679-5143, Japan

ABSTRACT

The density of a peridotite magma was measured up to 2.5 GPa and 2300 K using an X-ray absorption method. The method allowed measurement of the density of a peridotite melt under seven different conditions and clarified the pressure and temperature dependence of the density. A fit of the pressure-density-temperature data to the high-temperature Birch-Murnaghan equation of state yielded the isothermal bulk modulus, $K_{T0} = 24.0 \pm 1.3$ GPa, its pressure derivative, $K_0' = 7.3 \pm 0.8$, and the derivative of bulk modulus $(\partial K_T/\partial T)_P = -0.0027 \pm 0.0017$ GPa/K at 2100 K. The large bulk modulus and its pressure derivative of the peridotite melt compared with that of basaltic melt is consistent with previous results from sink-float experiments.

Keywords: X-ray absorption method, peridotite melt, density, high pressure, equation of state