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Density and seismic velocities of chromitite body in oceanic mantle peridotite

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ABSTRACT

Density and seismic velocities of the chromitite bodies from the Oman ophiolite were calculated and compared with those of oceanic peridotites. The Oman chromitite is composed of olivine and chromian spinel, and the olivine/spinel volume ratio varies from 20 to 90 vol%. Chromian spinel in the chromitite is enriched in magnesiochromite component, and Fo content of olivine ranges from 94 to 96. Compressibility of a natural chromian spinel [$(Mg_{0.77}Fe^{2+}_{0.23})(Cr_{0.46}Al_{0.50}Fe^{3+}_{0.04})O_4$] was measured with in situ synchrotron X-ray diffraction experiments, using a diamond anvil cell up to 10 GPa at 300 K. The third-order Birch-Murnaghan equation of state yields the isothermal bulk modulus of K_T = 192(7) GPa, its pressure derivative of K'_T = 4(1), and the zero-pressure volume of V_0 = 560.6(2) Å^3. Based on calculations using present and previous studies, the adiabatic bulk modulus of magnesiochromite component was estimated to be 189 GPa. Using petrological and the mineral physics data, density and seismic velocities (V_ϕ, V_P, V_S) were calculated. The seismic velocities are higher than those of peridotites in the oceanic upper mantle and decrease with decrease of the spinel/olivine ratio. The contrast between chromitite and oceanic peridotite are 5.0–8.1% for V_ϕ, 2.7–4.9% for V_S, and 4.1–6.7% for V_P in the Moho transition zone chromitite, and 2.6–6.5% for V_ϕ, 1.4–3.3% for V_S, and 2.2–5.2% for V_P in the discordant mantle chromitite. This contrast is large enough to be detected by seismological observations and becomes a key to knowing the distributions of chromitite in the oceanic upper mantle.

Keywords: Chromitite, oceanic peridotite, seismic velocities, ophiolite