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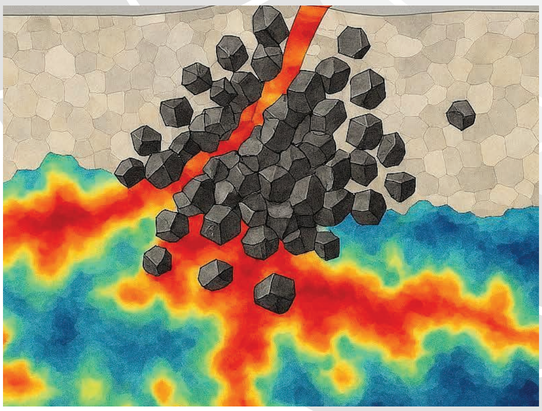
Venue: Meeting Room #486
Science Research Bldg. 1, 4th floor.
Ehime Univ.

Keywords

1. Seismic anisotropy
2. Deformation-induced crystallographic preferred orientation (CPO)
3. ε-FeOOH



Deformation experiments on ε-FeOOH at high-pressure and high-temperature

Phase H ($MgSiO_2(OH)_2$), one of the dense hydrous magnesium silicates, is a candidate mineral which may produce the observed seismic anisotropy in the uppermost lower mantle (Ferreira et al., 2019), because hydrous minerals can be produced by the reaction with water transported by subducted slab and phase H is known to have strong elastic anisotropy (Tsuchiya and Mookherjee, 2015). In this study, we have conducted high-pressure and high-temperature deformation experiments on ε-FeOOH which has same crystal structure as phase H and is stable at relatively lower pressures. Based on the results, we discuss role of phase H on the material transport and the seismic anisotropy in the uppermost part of the lower mantle.

Deformation experiments were conducted using D111-type apparatus installed at BL04B1, SPring-8 (e.g. Wu et al., 2024). Uniaxial compression, tensile tests, and simple shear deformation were carried out at ~12 GPa and 623-973 K. Using monochromatized synchrotron X-ray with energy of ~60 keV, stress and strain during deformation were determined in-situ. Crystallographic preferred orientation (CPO) was determined by analyzing recovered samples using SEM-EBSD.

Observed steady state stress during deformation at strain rate of 10^{-5}—10^{-4} s^{-1} was highly dependent on temperature where it was ~1.5-2.0 GPa at 623 K and ~0.3 GPa at 873 K. These flow stress values are significantly lower than those of anhydrous mantle minerals, suggesting possible occurrence of strain localization due to presence of phase H in the Earth's mantle. The CPO patterns of recovered samples from uniaxial compression, tensile tests, and simple shear deformation consistently showed that the dominant slip system under the studied condition is (010)[001]. Seismic anisotropy of deformed phase H was calculated using its elastic constants (Tsuchiya and Mookherjee, 2015). The results suggest that phase H deformed in horizontal shear in the Earth's lower mantle may yield shear wave polarization anisotropy of $V_{SV} > V_{SH}$.

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