Oral presentation | S3: Rheology and Material Transfer in Mantle and Crust (Special Session)

Thu. Sep 11, 2025 2:00 PM - 6:00 PM JST | Thu. Sep 11, 2025 5:00 AM - 9:00 AM UTC Oral Presentation C(Room No. 28)

S3: Rheology and Material Transfer in Mantle and Crust (Special Session)

Chairperson:Ikuo Katayama(Hiroshima University), Miki Tasaka(Shizuoka University), Tomoaki Kubo(Kyushu University)

Invited Lecture

2:00 PM - 2:25 PM JST | 5:00 AM - 5:25 AM UTC

[S3-01] Crystallographic preferred orientation of δ-AlOOH at high pressure and temperature: implications for seismic anisotropy in the deep mantle

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Shear-wave anisotropy has been widely observed in the lower mantle transition zone and the uppermost lower mantle, particularly near several subducting slabs (Ferreira et al., 2019; Nowacki et al., 2015). These seismic features are commonly attributed to the crystallographic preferred orientation (CPO) of constituent minerals. Understanding the rheological behavior of hydrous phases under relevant mantle pressure-temperature conditions is thus critical for elucidating the origin of such anisotropy and the mechanical behavior of hydrated subducting slabs.
Delta-AlOOH, a high-pressure polymorph of diaspore with orthorhombic symmetry (Suzuki et al., 2000), exhibits over 27% shear-wave anisotropy in its single crystal under mid-mantle conditions (Tsuchiya et al., 2009). Delta-AlOOH forms a solid solution with phase H—referred to as phase delta-H [AlOOH–MgSiO2(OH)2]—that remains stable from approximately 18 GPa to lowermost mantle depths. Phase delta-H can coexist with bridgmanite or post-perovskite in hydrous lithologies (Ohira et al., 2014; Duan et al., 2018), making it a significant carrier of water into the deep mantle. The rheological behavior of Delta-AlOOH and phase Delta-H is therefore likely to influence the deformation and dynamics of deep subduction zones.
We conducted deformation experiments on pre-synthesized Delta-AlOOH and phase Delta-H [Delta-(Al,Mg,Si)OOH] aggregates at pressures of 21-25 GPa and temperatures of 700-1000 degrees C, using strain rates of 1.6 x 10^-4 to 5 x 10^-5 s^-1—conditions representative of the lower mantle transition zone. Microstructural and CPO analyses of the recovered samples revealed that both Delta-AlOOH and phase Delta-H deformed by dislocation creep and developed a pronounced (010) fabric perpendicular to the compression direction, with [001] identified as the dominant slip direction.
The deformation fabrics observed in Delta-AlOOH and phase Delta-H may account for the ubiquitous shear-wave anisotropy (VSV > VSH, where VSV and VSH are vertically and horizontally polarized shear waves, respectively) detected near the tops of stagnant slabs in the lower mantle transition zone or uppermost lower mantle.