EGU26-19103, updated on 11 Nov 2026
https://doi.org/10.5194/egusphere-egu26-19103
EGU General Assembly 2026
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Seismic detectability of a deformation-induced anisotropic discontinuity in the Earth's lower mantle around a subduction zone using synthetic global modeling of SS precursors

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Bridgmanite is the most abundant intrinsically-anisotropic constituent of the lower mantle. Its deformation, thus, potentially translates to large-scale anisotropy that would accumulate in high-stress regions, particularly the interaction between subducted materials and the surrounding mantle. While most of the lower mantle is generally considered well-mixed, recent observations suggest structures at mid-mantle depths (800 – 1500 km). Their origin, however, often remains enigmatic. Recent state-of-the-art deformation experiments in bridgmanite at lower-mantle temperatures and pressures reveal a depth-dependent behavior of anisotropy. Coupled with realistic geodynamic models of mantle convection, the large-scale imprint of the depth-dependent fabric reveals a purely deformation-driven seismic discontinuity between 1000 – 1400 km depth that matches observations. The discontinuity appears sharpest in actively deforming regions, and becomes negligible closer to neutral ones. In this work, we investigate its seismic detectability around a subduction zone using three-dimensional global waveform modeling via AxiSEM3D. Given its likely presence across a broad range of frequencies, we assess the suitability of SS precursors for detecting this feature. Enhanced using array seismological methods, results show the presence of SS precursors in the transverse component generated by the anisotropic discontinuity. In addition, a flattened slab geometry produces a shallower SS precursor due to the interface formed between an overlying isotropic slab and an underlying strongly anisotropic (V_{SH}>V_{SV}) layer. We examine the azimuthal dependence of precursor amplitudes and their frequency dependence, with particular emphasis on the microseismic frequency band (~0.05 – 0.25 Hz). In light of these recent findings, we discuss its implications on the nature and origin of mid-mantle discontinuities.