Imaging paleoslabs and inferring the Clapeyron slope in D″ beneath the northern Pacific based on high-resolution inversion of seismic waveforms for 3-D transversely isotropic structure

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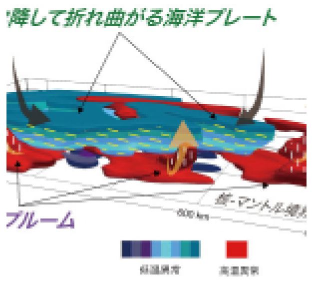

Press Release

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Highlights

- We use waveform inversion to infer 3-D local V_S and anisotropy structure in D″.
- We image Izanagi, Farallon, and Telkhina slabs in D″ beneath the northern Pacific.
- Hot upwelling plumes are forming at the edges of the descending cold slab.

- Inferred Clapeyron slope is 10.2 ± 1.3 MPa/K in D″ beneath the northern Pacific.

Abstract

We use waveform inversion to infer high-resolution 3-D models of the S-velocity perturbation δV_S and the anisotropy parameter $\delta\xi$ in the lowermost 400 km of the mantle beneath the northern Pacific. Our inferred models show three prominent features: (i) a widespread positive δV_S layer with ~100 km thickness that exists ~250 km above the core-mantle boundary (CMB), which could be due to a bridgmanite to post-perovskite phase transition related to the D″ discontinuity; (ii) distinct positive $-\delta V_S$ anomalies with positive $\delta\xi$ resolved from 100 km to more than 400 km above the CMB, which could be the subducted Izanagi, Farallon, and Telkhinia slabs; (iii) a vertically continuous low-δV_S anomaly with negative $\delta\xi$ at the edge of the subducted slab, which we interpret as an upwelling plume induced by slab sinking. We infer the Clapeyron slope of the post-perovskite phase transition in the lowermost mantle beneath the northern Pacific to be 10.2 ± 1.3 MPa/K, based on the δV_S gradient as a function of depth for the inferred 3-D V_S structure. Our estimated large positive Clapeyron slope at the CMB suggests vigorous convection in the lowermost mantle.

Graphical abstract