When Slab met Plume at the Core-Mantle Boundary

Prof. Daoyuan Sun

University of Science and Technology of China

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Abstract

D” represents one of the most dramatic thermal and compositional layers within our planet. In particular, global tomographic models display relatively fast patches at the base of the mantle along the circum-Pacific which is generally attributed to slab-debris. Such distinct patches interact with the bridgmanite (Br) to post-bridgmanite (PBr) phase boundary to generate particularly strong heterogeneity at their edges. Most seismic observations for the D” come from the lower mantle S wave triplication (Scd). Here, we exploit the USArray waveform data to examine one of these sharp transitions in structure beneath Alaska. From west to east beneath Alaska, we observed three different characteristics in D”: 1) The western region with a strong Scd requires a sharp δV_S = 2.5% increase; 2) The middle region with no clear Scd phases that indicates a lack of D” (or thin Br-PBr layer); 3) The eastern region with strong Scd phase requires a gradient increase in δVs. To explain such strong lateral variation in the velocity structure, chemical variations must be involved. We suggest that the western region represents relatively normal mantle. In contrast, the eastern region is influenced by a relic subducted slab that has reached the lowermost mantle. In the middle region, we infer an upwelling structure that disrupts the Br-PBr phase boundary. This is based upon a distinct pattern of travel time delays, waveform distortions, and amplitude patterns that reveal a circular-shaped anomaly about 5° across which can be modeled synthetically as a plume-like structure rising about 400km high with a shear velocity reduction of ~ 5%, similar to geodynamic modeling predictions.

~ All are Welcome! ~

Enquires: 3943 9624 essc@cuhk.edu.hk