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Dome-like low velocity upwelling in D" beneath Alaska imaged with USArray data

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The lowermost mantle region, D", represents one of the most dramatic thermal and compositional layers within our planet. Global tomographic models display relatively fast patches along the circum-Pacific which are generally attributed to slab-related debris. Most seismic observations for the D" boundary layer come from the lower mantle S wave triplication (Scd). However, the most sampled regions are concentrated beneath Central America, where intensive studies, including migration methods and array analysis, have been accomplished. Beneath Central America, the D" can have a step variation of $\sim$100 km, which argues strong lateral temperature variations or possible chemical variations. However, the commonly used ray paths between South American events and seismic stations in North America sample this sharp boundary azimuthally, which is difficult to model. Here, we exploit the USArray waveform data to examine a sharp transition beneath Alaska. From west to east beneath Alaska, we observe three different types of structures in the D" layer: in the western region we observed a strong Scd phase, which requires a sharp δVS = 2% increase; in the middle region there is no clear Scd phase indicating no D" layer; in the eastern region we observe a strong Scd phase requiring a positive gradient δVS. To explain such strong lateral differences in seismic velocity, we propose a chemical variation. We suggest that the western region represents a "normal" lowermost mantle. In contrast, the eastern region has fast velocities, which appears to influenced by the subducted Pacific slab. In the middle region, we interpret an upwelling structure that disrupts the phase boundary. This is based upon observations of a distinct pattern of travel time delays, waveform distortions, and amplitude patterns which reveal a circular anomaly about 5° across which can be modeled synthetically as a dome about 400 km high with a low shear velocity reduction of $\sim$5%. Numerical modeling indicates that this structure could be the base of an upwelling and/or a hot Fe-rich oxide hill that is influenced by the subducted Pacific plate.