Full-wave tomography in Alaska/Aleutian from ocean to continent

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The Alaska/Aleutian subduction margin is one of the most active convergent plate boundaries, with prominent variations of seismogenic properties, volcanic activities, and lithospheric deformations observed along strike and down dip. However, the detailed characteristics and origin of the segmentations are not well understood. For example, what is the role of the oceanic lithosphere on the along-strike variations of volcanism/magmatism? To what extent does the continental lithosphere deform due to subduction along the margin? To address these questions, we have constructed a high-resolution shear velocity model for the crust and upper mantle in Alaska, using full-wave ambient noise tomography. We utilize an integrated data set from multiple seismic networks in Alaska, including the EarthScope Transportable Array and many permanent and flexible deployments (Fig. 1a). We highlight a few key observations: (1) Within the upper crust, a distinct slow-fast velocity contrast is observed across the Denali Fault (Figs. 1b & 1f). (2) A high-velocity anomaly with the horizontal scale of about 300 km is imaged beneath the Denali Volcanic Gap at depths greater than 80 km (Figs. 1c & 1e). (3) The geometry of the oceanic lithosphere varies both along strike and down dip (Figs. 1d - 1g). The transition from the normal-dipping Pacific plate (Fig. 1d) to the more gently subducting Yakutat plate (Fig. 1e) is clearly imaged. And (4) Low-velocity anomalies are imaged below the Pacific and Yakutat oceanic lithosphere prior to subduction (Figs. 1e & 1g), which define a clear lithosphere-asthenosphere boundary. We suggest that the high-velocity anomaly beneath the Denali Volcanic Gap may be stagnant or flattened Yakutat slab. The flat-slab subduction of the Yakutat plate may have reduced slab dehydration and melt generation, resulting in the Denali Volcanic Gap. Wrangell volcanoes may originate from corner flows at the edge of the subducting slab. We will explore probable interpretations of the observed seismic features in the near future to better understand the underlying lithospheric dynamics in Alaska/Aleutian.

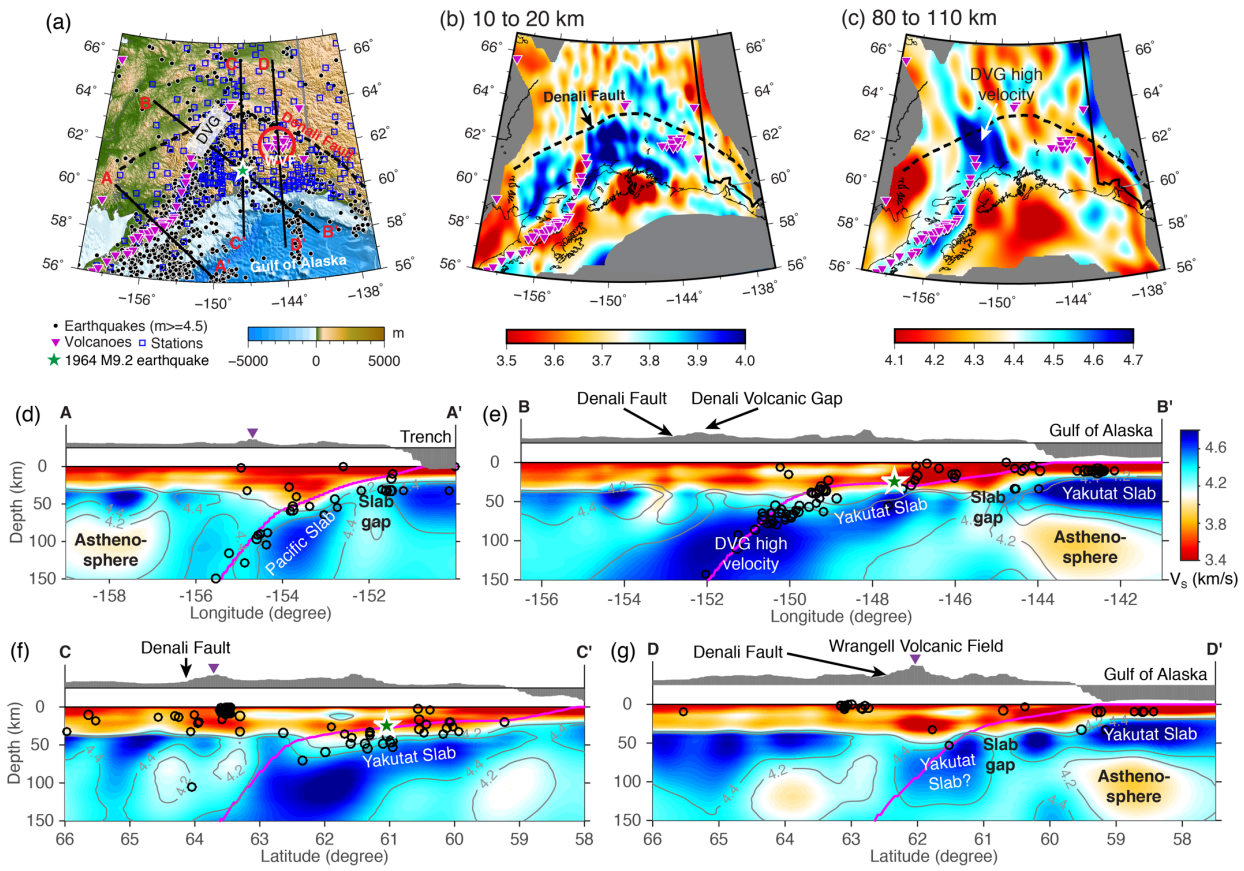

Figure 1. Regional tectonic settings and shear velocity model from full-wave tomography. (a) Seismicity, volcanoes, and major structures in the study area. DVG: Denali Volcanic Gap. WVF: Wrangell Volcanic Field. (b) - (c) Averaged shear wave velocities at depths of 10-20 km and 80-110 km, respectively. The dashed line in each panel marks the Denali Fault. (d) - (g) Shear velocity profiles at a depth range of 0-150 km. The projected earthquakes (m>=4.5) are within a 25 km distance from the profiles. The purple line in each profile is the slab interface from model E325 by Jadamec and Billen (2010). See (a) for profile locations. Major velocity features are labeled.

Reference for slab model E325:

Jadamec, M. A., and M. I. Billen (2010), Reconciling surface plate motions with rapid three-dimensional mantle flow around a slab edge, *Nature*, *465*(7296), 338-U389, doi:10.1038/nature09053.