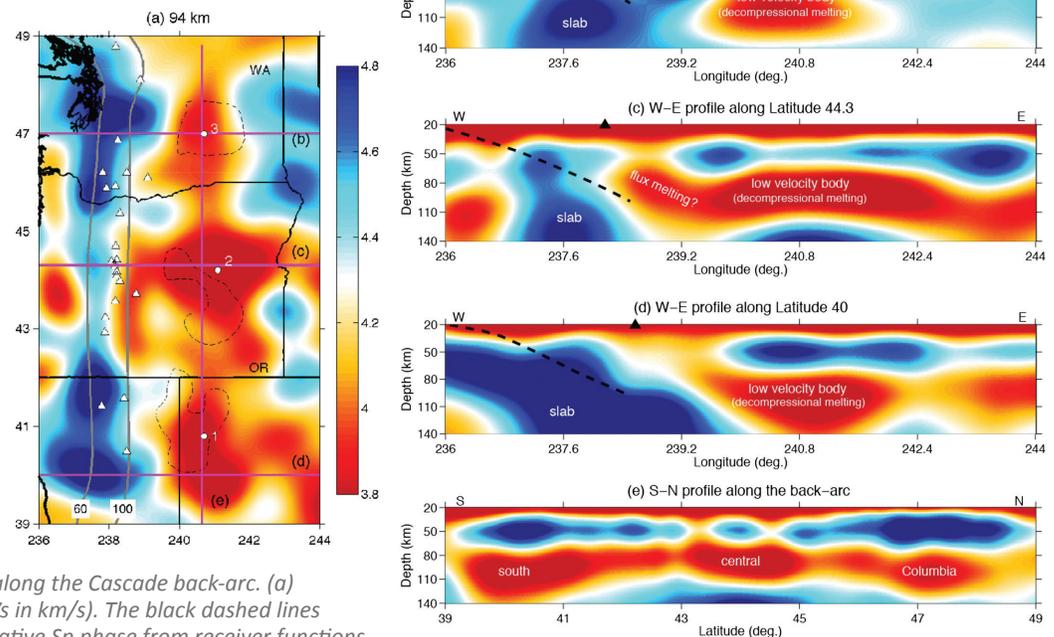


Small-scale mantle convection in the back-arc modulates volcanic activities along the Cascade arc

Haiying Gao and Yang Shen

Using continuous ground motion recorded by over one thousand seismic stations in the Pacific Northwest from the northern California to Washington State, Prof. Yang Shen and Dr. Haiying Gao extracted data that represent seismic waves that propagate between pairs of the stations along the Earth surface. From those data, they constructed a wave speed model for the crust and upper mantle in the region with a tomographic method that fits the observed waveforms and the synthetics from 3D wave propagation simulation. The model reveals three low-velocity volumes in the mantle east of the Cascadia volcanic arc, which are spatially correlated with the three arc-volcano clusters. These low-velocity volumes indicate upwelling of hot mantle

induced by the subduction of the Juan de Fuca plate underneath the North America plate. The magnitude of the velocity reduction in those volumes requires the presence of partial melt. The along-strike variations in the velocity structure suggest that the large-scale plate-motion-induced flow in the back-arc mantle is modulated by small-scale convection, resulting in a highly 3D process that defines the segmentation of volcanism along the Cascade arc. ■



Segmented low-velocity anomalies along the Cascade back-arc. (a) Horizontal slice at depth of 94 km (V_s in km/s). The black dashed lines outline the amplitude of largest negative S_p phase from receiver functions in the back-arc (Hopper et al., 2014). The magenta lines mark the profile locations in (b), (c), (d) and (e), respectively. All the panels share the same color bar. (b-d) W-E profiles across the back-arc anomalies. The y-axis has the approximate same length scale as the x-axis. The triangles mark the volcano centers. The Juan de Fuca plate interface at depths of 20-100 km from the model of McCrory et al. (2006) is projected. At greater depth, the plate interface is poorly defined. (e) S-N profile along the back-arc low-velocity anomalies, which spatially correlate with the three volcano clusters along the Cascadia. The length scale of y-axis is exaggerated two times of the x-axis. Gao and Shen (2014).

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