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A variety of subduction styles shaped the mantle beneath North America

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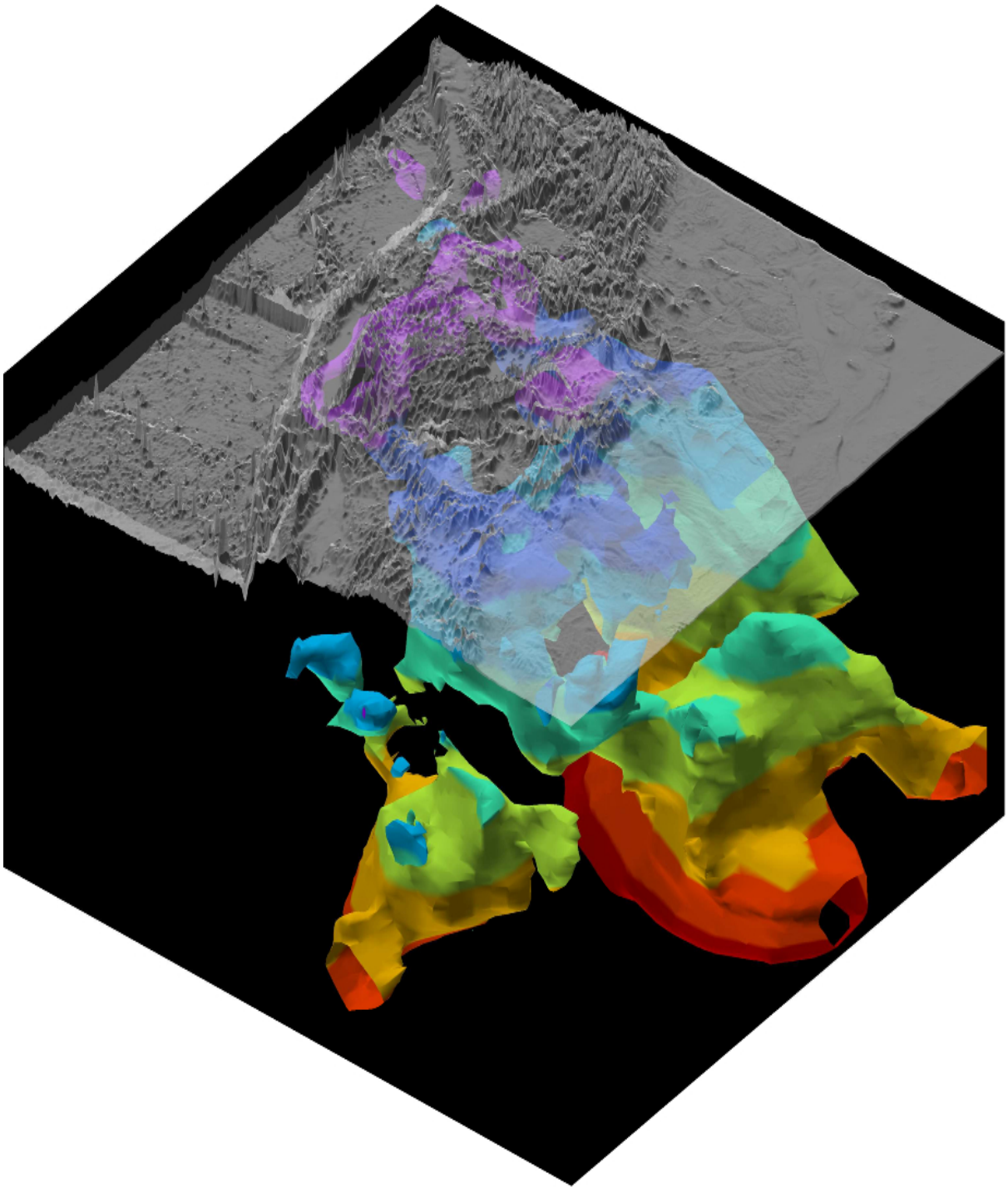

Seismic tomography studies of the upper and lower mantle beneath North America have tremendously improved in resolution over the past few years. This is largely due to the dense broadband station deployment of USArray, and to waveform-based, computationally ambitious new tomography techniques. We use finite-frequency data and modeling in seven frequency passbands (dominant periods between 21 and 2.7 s) to jointly invert P-wave traveltime and amplitude anomalies for velocity and attenuation structure. Resolution reaches down to about 180 0 km depth.

The mantle under all of North America is dominated by remnants of the previously huge Farallon plate, consistent 150 Myr of continuous subduction beneath the continent's western margin, as inferred from plate tectonic reconstructions. The subducted plate is pervasively fractured by several tears spanning thousands of kilometers, and different fragments exemplify different styles of subduction. A first-order, lateral slab break running from western Canada to the Gulf of Mexico, separates the western province of current, "normally" steep subduction from an eastern province, where vast volumes of older Farallon fragments seem to be stagnating in the transition zone.

Plate reconstructions provide only vague hints at the causes for these observed, major slab breaks and complexities. However, other geological observations have always pointed to a much more complex tectonic history than might be expected from 150 Myr of textbook-like subduction of a single plate. An episode of extremely flat subduction has been inferred for 70 to 50 Myr from mountain-building far inland. Various ocean arcs accreted to the west coast could also hold clues to observed disruptions. We will discuss our current understanding of how these surface observations relate to the observed underground geometries, in a kinematic and dynamic sense. This includes the possible origins and functioning of Yellowstone, one of the few presumed continental mantle plumes. In light of the new images, its story appears to be closely intertwined with Cenozoic subduction geometry.

Keywords: seismic tomography, mantle dynamics, stagnant slab, Yellowstone, body waves, finite-frequency