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Imaging and modelling the titled Yellowstone Plume

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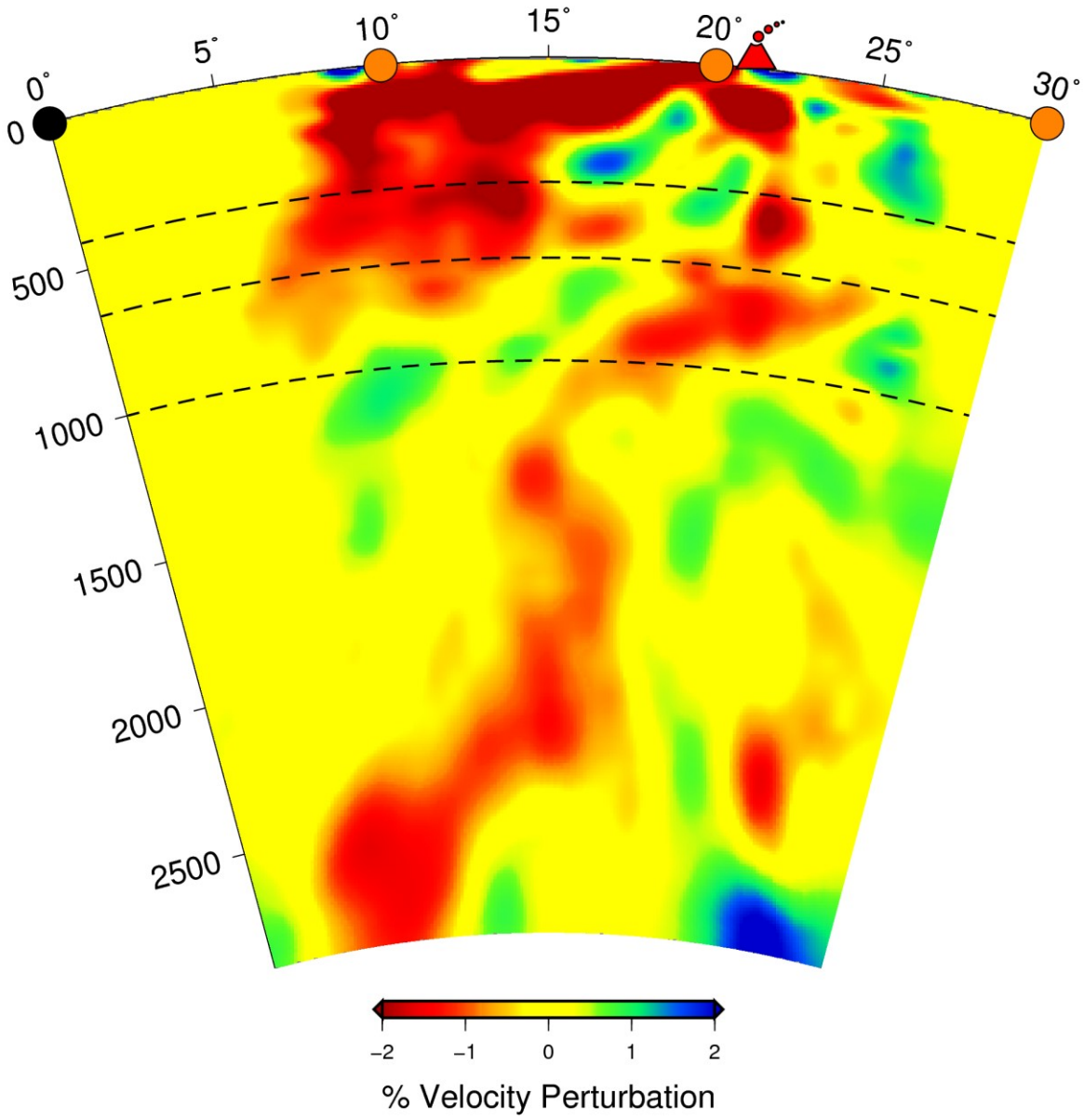
The Yellowstone Hotspot is an intraplate source of magmatism whose cause has been highly debated. Some argue that a deep mantle plume supplies the heat beneath Yellowstone while others claim subduction or lithospheric related processes can explain the anomalous magmatism. Here we present a shear wave tomography model for the deep mantle beneath the western United States that was made by carefully measuring the travel times of SKS/SKKS waves recorded by the dense USArray seismic network to pick out shortwave length sub vertical features in the lower mantle. The final model shows a single narrow (~350 km diameter) cylindrically shaped slow anomaly that we interpret as a whole mantle plume. The anomaly is strongly tilted to the northeast and extends from the core-mantle boundary beneath San Diego to the surficial position of the Yellowstone Hotspot. As a test to see if the imaged tilt and source location is reasonable, we perform numerical computations of plumes deflected in large-scale mantle flow to find if a set of realistic model parameters exist that can fit our observations well. For a plume head reaching the surface 17 Myrs, corresponding to the start of the Columbia River Flood Basalts, we are able to match the shape and location of the conduit using a range of current global tomography models if the rise time is ~80 Myrs or longer.


0°
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