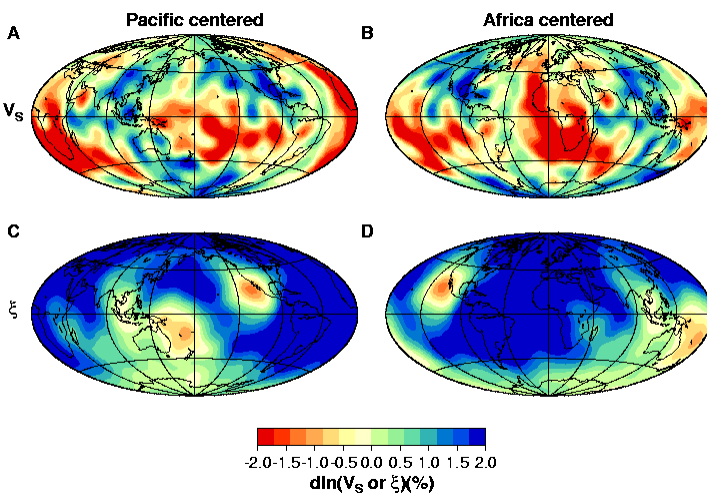


A THREE DIMENSIONAL RADially ANISOTROPIC MODEL OF SHEAR VELOCITY IN THE WHOLE MANTLE

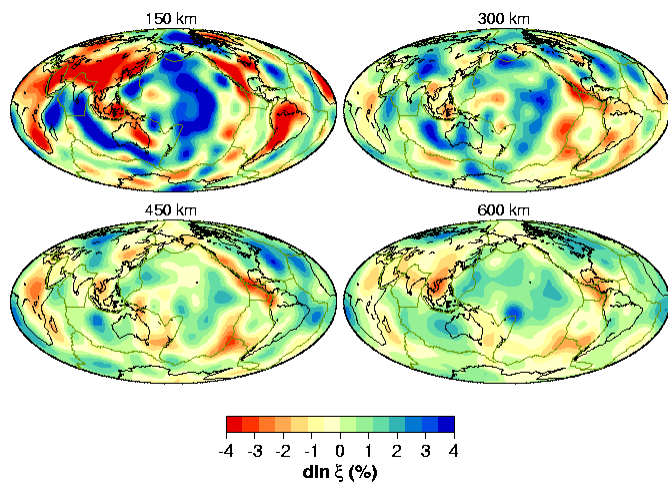
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While the 3D isotropic seismic velocity structure of the Earth's mantle represents a snapshot of its current thermal and chemical state, the anisotropy of seismic velocities can give us a constraint on mantle dynamics. Nearly all the constituent minerals of the mantle have strongly anisotropic elastic properties on the microscopic scale. Random orientations of these crystals tend to cancel out this anisotropy on the scale observable by seismic waves, unless crystals or materials with strongly contrasting elastic properties are aligned through deformation processes. While in the relatively cold regions of the lithosphere these anisotropic signatures can remain frozen in over geologic time-scales (Silver, 1996), observed anisotropy at greater depths likely requires dynamic support (Vinnik et al., 1992). Thus, the anisotropy observed at sub-lithospheric depths is most likely a function of the current mantle strain field, and can help us map out mantle flow.

We have developed a 3D radially anisotropic shear velocity model of the whole mantle using a large three component surface and body waveform dataset, derived primarily from IRIS GSN as well as Geoscope stations, using an iterative inversion for structure and source parameters based on Nonlinear Asymptotic Coupling Theory (NACT) (Li and Romanowicz, 1995). The model is parameterized in terms of isotropic VS and an anisotropic parameter, ξ , which is defined by $\xi = V_{SH2}/V_{SV2}$. The model shows a link between mantle flow and anisotropy in a variety of depth ranges.



Isotropic VS (top) and ξ (bottom) structure at 2800 km depth, centered under the Pacific (left) and Africa (right).



ξ structure at four depths in the upper mantle and transition zone.

The isotropic VS model matches the common features of S tomographic models. The uppermost 200 km shows tectonic features, with fast velocities in the continental interiors and slower oceans and tectonically active regions. In the transition zone, the most prominent features are the fast subducted slabs. Mid-mantle velocity anomalies are low in amplitude, and white in spectrum. In the lowermost 500 km, the amplitudes of heterogeneity increase, and show a degree 2 pattern with rings of higher velocities surrounding two lower velocity regions under the central Pacific and Africa.

In the ξ model of the upper mantle (Figure 1), we observe positive anomalies ($V_{SH} > V_{SV}$) starting at ~ 80 km under oceanic regions and ~ 250 km under old continents, suggesting horizontal flow beneath the lithosphere (Gung et al., 2003). We also observe a $V_{SV} > V_{SH}$ signature at ~ 200 -300 km depth beneath major ridge systems with amplitude correlated with spreading rate. In the transition zone (400-700 km), regions of subducted slab material are associated with negative ξ anomalies ($V_{SV} > V_{SH}$) (Figure 1), while the ridge signal decreases except under the East Pacific Rise.

We also observe strong radially symmetric $V_{SH} > V_{SV}$ in the lowermost 300 km (Figure 2) (Panning and Romanowicz, 2004). The 3D deviations from this degree 0 signature are associated with the transition to the large-scale superplumes under the central Pacific and Africa, suggesting that $V_{SH} > V_{SV}$ is generated in the predominant horizontal flow of a mechanical bound-

ary layer, with a change in signature related to transition to upwelling at the superplumes.

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