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Vertical coherency of heterogeneity in the Earth's mantle constrained from a comprehensive set of global seismic data.

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We analyze a newly compiled, massive, and diverse set of global seismic measurements to understand better the spatial and spectral character of imaged mantle shear wave anomalies and their uncertainties. Paying particular attention to the role of data selection, regularization, and model parameterization, we strive to explore a number of relevant concepts in mantle dynamics, including the amount of vertical downward (slabs) and upward (plumes) mass transport, and changes in spectral heterogeneity character with depth below 660 km in the mid mantle. These issues and their geodynamic implications have been debated vigorously, yet there are no firm conclusions as to the robustness of seismological inferences.

To answer some of the related questions, we have compiled a new global seismic database that combines a variety of seismic phases, measured by independent authors with often profoundly different techniques: various sets of (refracted and/or multiply reflected) shear-wave traveltimes, three sets of Love- and Rayleigh-wave fundamental modes, and two sets of Love- and Rayleigh-wave overtones. We have developed new tomography software to invert such databases jointly, accounting accurately for radial anisotropy throughout the mantle, and for the nonlinear effects of crustal heterogeneity (based, at this stage, on a global a-priori model).

We present the results of a suite of tomographic inversions, allowing for more or less complicated structure in various regions of the mantle. In particular, we explore the possibility of strong vertical gradients (or discontinuities) in structure and spectra at various depths, by iteratively modifying our vertical parameterization and regularization in different depth ranges. Preliminary results indicate that the data prefer a break in spectral character with an enhancement of shorter wavelength anomalies below the upper mantle transition zone, as suggested earlier. However, this break may in fact occur at depths significantly below the 660 km phase change. Comparison of the seismological power spectra maps with heterogeneity maps from recent spherical convection computations shows that such changes in power spectra with depth may, moreover, be compatible with whole mantle convection.