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P-wave velocity structures under the western hemisphere using multi-frequency tomography

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We present a preliminary new P-wave tomography of the whole-mantle structure under the hemisphere of North, Central and South America. It is constructed using multi-frequency tomography, a waveform-based inversion method that exploits the entire usable frequency content of body-wave seismograms. Waveforms from almost 3500 teleseismic earthquakes of mb >= 5.6 are used, recorded between 1990 and 2016 by regional and global networks, which includes the full record of the USArray. Source time functions were estimated for all earthquakes, a requirement for computing sufficiently realistic synthetic seismograms. Traveltime anomalies of P wave arrivals were measured by cross-correlating the synthetic and observed seismograms in eight frequency bands (dominant periods 2.7∼s to 30∼s). Frequency-dependent effects of the waves are accounted for by calculating finite-frequency sensitivity kernels. To better illuminate poorly sampled mantle regions, we include short period traveltimes from the International Seismological Centre's EHB catalogue.

Seismically fast anomalies dominate the central and eastern parts of the North American mantle, interpreted as subducted lithosphere. Broad seismically slow anomalies are located beneath the western parts of the Americas, from Alaska to the southern coast of Peru. This distinctive division is observed down to 1100 km depth, where a linear, north-south trending track of seismically fast anomalies dominates the mantle from eastern Canada to the north-western latitudes of South America. Massive, linear, fast anomalies also dominate at deeper depths, presumably reflecting the continuous, long-lived trench geometries into which the imaged paleo-seafloor subducted. There is a pronounced, arc-shaped high-velocity anomaly under the Lesser Antilles, which is apparent down to 850 km depth.
The new high-resolution images provide an opportunity for better interpretation or re-interpretation of the tectonic histories of the Americas.