We present the results of a joint inversion (Yuan and Romanowicz, 2010; Yuan et al., 2011) of long period seismic waveforms and SKS splitting measurements for 3D lateral variations of anisotropy in the upper mantle beneath the western US, incorporating recent datasets generated by the USArray deployment as well as other temporary stations in the region. We find that shallow azimuthal anisotropy (Figure 1) closely reflects plate motion generated shear in the asthenosphere in the shallow upper mantle (70-150 km depth), whereas at depths greater than 150 km, it is dominated by northward and upward flow associated with the extension of the East-Pacific Rise under the continent, constrained to the east by the western edge of the north-American craton, and to the north, by the presence of the East-West trending subduction zone.

The depth integrated effects of the western US upper mantle anisotropy (Figure 2) explain the apparent circular pattern of SKS splitting measurements observed in Nevada without the need to invoke any local anomalous structures, e.g. ascending plumes or sinking lithospheric instabilities (Savage and Sheehan, 2000; West et al., 2009); the circular pattern results from the depth-integrated effects of the lithosphere-asthenosphere coupling to the NA, Pacific and JdF plates at shallow depths, and in the depth range 200-400 km, northward flow from the EPR.
channeled along the craton edge and deflected by the JdF slab, and more generally slab related anisotropy.

The strong lateral and vertical variations throughout the western US revealed by our azimuthal anisotropy model reflect complex past and present tectonic processes. In particular, the NA and Pacific plate shear is dominant shallower than 150 km; at 150 km east-west flow is present due to the JdF slab rollback; and at > 350 km the east-west directed anisotropy is associated with frozen-in/structural anisotropy in the stagnant/flattened JdF slab (Figure 3). With the accumulating high quality TA data, surface wave azimuthal anisotropy combined with multiple layer SKS splitting modeling (e.g., Özalaybey and Savage, 1995; Levin et al., 1999; Yuan et al., 2008) now make it possible to resolve complex depth dependent anisotropic domains in the North American upper mantle.

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