Geophysical Research Abstracts
Vol. 12, EGU2010-3498-1, 2010
EGU General Assembly 2010

SKS splitting and upper mantle geodynamic under California

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We performed teleseismic shear wave splitting measurements for 65 permanent (Berkeley, Caltech and Geoscope) and temporary (USArray and California Transect) broadband stations in Central California to study the vertical and lateral extent of the deformation beneath the San Andreas Fault System and to investigate interactions between lithosphere and asthenosphere in a transpressional plate boundary. The type of anisotropy detected at the different stations fall into two categories: either one with clear E/W trending fast directions and delay times in the range 1.5 to 2.0s, found at stations far from the San Andreas fault (SAF) system, or one where both the fast azimuth and delay times scatter considerably, for stations closer to the SAF system. In the latter case, the scatter is related to azimuthal variations of the splitting parameters that can be modeled by two anisotropic layers. The upper of the two layers provides fast directions in the range N30°W to N50°W, close to the strike of the main Californian faults (N35°W to N45°W) and averaged delay times of 0.7s; the lower layers show E/W directions and delay times in the range 1.5 to 2.5s and are therefore close to what is observed in stations that require only a single layer. We propose that the E/W trending anisotropic layer observed beneath all of California is 150 to 200 km thick and is located within the asthenosphere. Its deformation is likely due to absolute motion of the North American lithosphere overlying the asthenosphere and it may therefore be characterized by a horizontal foliation with E/W lineation. The other anisotropic layer ought to be related to the dynamics of the San Andreas Fault system and is probably characterized by a lithospheric vertical foliation with lineation parallel to the strike of the faults. Using the large amounts of data and the dense seismological coverage available in California, we are able to propose that this anisotropic layer is about 40 km broad at 70 kilometers depth beneath each fault of the San Andreas Fault System, and that the faults extend into the lithospheric mantle.