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Deep Structure of Continental Strike-slip Faults Imaged by Receiver Functions

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The depth extent of continental strike-slip faults and associated lower crustal deformation are still much debated. Scientific literature is recently centered on two competing models. In the first model the transition from brittle to ductile deformation occurs within the crust where strike-slip faults become a broad shear zones in the lower crust. This model predicts lack of Moho offset, spatial variation of displacement and resultant seismic anisotropy in the lower crust. In the second model, lower crust and mantle lithosphere are rigid and strike-slip faults cut the entire crust as narrow shear zones. This deformation style may create Moho offset across faults that juxtapose two crustal blocks with different thicknesses. Determining which of these two models most accurately describes the lithospheric deformation has important tectonic implications. In this respect, teleseismic receiver functions (RFs) are very powerful on determining Moho structure, possible Moho offsets and crustal anisotropy. In this study, we computed teleseismic RFs from broadband seismic data recorded by 39 stations deployed temporarily along the central segment of North Anatolian Fault (NAF) as a part of the North Anatolian Fault Passive Seismic Experiment (2005-2008) and stations of the Southern California Seismic Network that are located in the vicinity of active continental strike-slip faults in Southern California (San Andreas Fault - SAF, Garlock Fault, San Jacinto Fault and Elsinore Fault). Across the NAF, the analysis of RFs indicates sharp crustal variations and noticeable Moho offsets. Near Parkfield, RFs show evidence for the presence of a fossilized anisotropic fabric of past Farrallon plate subduction in lower crust beneath the SAF that contradicts with the resent sense of shear. Also, a remarkable Moho offset is imaged beneath the Elsinore Fault in Southern California. Although these results are not yet conclusive, they are consistent with rigid lithospheric-scale faulting in a narrow shear zone.