IMAGING THE SHALLOW INTERNAL STRUCTURE OF THE SAN JACINTO FAULT ZONE WITH HIGH FREQUENCY SEISMIC NOISE

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Recent tomography studies using local earthquakes and up to 3 s seismic noise provided detailed images of the region around the San Jacinto Fault Zone (SJFZ) in southern California, with nominal horizontal resolution of 1-2 km over the depth interval 0.5-15 km (Allam & Ben-Zion 2012 [1]; Allam et al. 2014 [2]; Zigone et al. 2015 [5]). To obtain high resolution information on local structures at the shallower crust, we cross correlate ambient seismic noise between 10 Hz and 70 Hz recorded by several linear arrays across the SJFZ with typical inter-station distances of 25-50 m. Following pre-processing involving earthquakes removal and whitening on 15 minutes time windows, we compute the 9-component correlation tensors for all station pairs. The obtained cross correlations exhibit coherent phase arrivals up to 30-40 Hz, which travel between the station pairs. Polarization and dispersion analyses show that both body and surface waves are reconstructed, with average Rayleigh group velocity around 450 m/s. The group velocity measurements on paths with sufficient signal to noise ratios are inverted with the Barmin et al. (2001) [3] approach using a 20 m grid size. The obtained maps reveal low velocity damage zones near the surface fault traces, with variations along strike reflecting various faulting behavior in different sections of the SJFZ. Three-dimensional images of shear wave speeds, derived with the inversion method of Herrmann (2013) [4], show local flower-shape damage structures in the top 200 m. The imaged Vs values at 30 m depths are around 250-300 m/s in agreement with available Vs30 results. These results demonstrate that close spacing between sensors allows imaging the subsurface material even at complex fault zone regions. The imaging method can be broadly utilized using the increasing number of dense deployments in various tectonic contexts.

References

[1] Allam, A. A. and Y. Ben-Zion (2012), *Seismic velocity structures in the Southern California plate- boundary environment from double-difference tomography*, Geophys. J. Int., **190**, 1181-1196, doi: 10.1111/j.1365-246X.2012.05544.x.

[2] Allam, A. A., Y. Ben-Zion, I. Kurzon, and F. L. Vernon (2014), *Seismic velocity structure in the Hot Springs and Trifurcation Seismicity Cluster Areas of the San Jacinto Fault Zone from double- difference tomography*, Geophys. J. Int., **171**, 2993-3011, doi: 10.1007/s00024-014-0784-0.

[3] Barmin, M., M. Ritzwoller, and A. Levshin (2001), *A fast and reliable method for surface wave tomography*, Pure Appl. Geophys., **158(8)**, 1351-1375.

[4] Herrmann, R. B. (2013), *Computer programs in seismology: An evolving tool for instruction and research*, Seism. Res. Lettr. **84**, 1081-1088, doi:10.1785/0220110096

[5] Zigone, D., Y. Ben-Zion, M. Campillo, and P. Roux, (2015), *Seismic tomography of the Southern California plate boundary region from noise-based Rayleigh and Love waves*, Pure Appl. Geophys., **172**, 1007-1032, doi: 10.1007/s00024-014-0872-1.