The 30th IUGG Conference on Mathematical Geophysics
Session 6

Multi-scale noise-based imaging of the San Jacinto Fault Zone environment

D. Zigone[1], Y. Ben-Zion[1], M. Campillo[2] and P. Roux[2]

[1]University of Southern California, Department of Earth Sciences, Zumberge Hall of Science (ZHS), 3651 Trousdale Pkwy, Los Angeles, CA 90089-0740, United States.
[2]Institut des Sciences de la Terre, Université Joseph Fourier, CNRS, IRD, BP 53, 38041, Grenoble, France.

We use noise-based tomography with various frequency bands and station separations to perform a multi-scale study of the crustal structures in the San Jacinto Fault Zone (SJFZ) environment.

Cross correlations of ambient seismic noise between pairs of 158 stations are used to investigate the velocity structure over the top 7-10 km of the crust at a regional scale around the SJFZ. We derive from the 9-component correlation tensors associated with all station pairs dispersion curves of Rayleigh and Love wave group velocities. The dispersion results are inverted first for Rayleigh and Love waves group velocities maps and then for shear wave velocities on a 1.5 km^2 grid that includes portions of the SJFZ, the San Andreas Fault (SAF) and the Elsinore fault. The distributions of the Rayleigh and Love group velocities exhibit 2θ azimuthal anisotropy with fast directions parallel to the main faults and rotations in complex areas. The reconstructed 3D shear velocity model reveals complex shallow structures that are correlated with the main geological units, and show strong velocity contrasts across various fault sections along with low velocity damage zones and basins. The SJFZ is marked by a clear velocity contrast with higher Vs values on the NE block for the section SE of the San Jacinto basin and a reversed contrast across the section between the San Jacinto basin and the SAF. Velocity contrasts are also observed along the southern parts on the SAF and Elsinore fault, with a faster southwest block in both cases. Strong velocity reductions following flower-shape with depth are observed extensively around both the SJFZ and the SAF, and are especially prominent in areas of geometrical complexity. In particular, the area between the SJFZ and the SAF is associated with extensive low velocity zone that is correlated with diffuse seismicity at depth, and similar pattern including correlation with deep diffuse seismicity is observed at a smaller scale in the trifurcation area of the SJFZ.

The above results give detailed images up to the top 500 meters or so of the crust. To obtain additional high resolution information on local structures at the very shallow crust we use cross correlation of high frequency noise between 20 Hz and 70 Hz recorded by several linear arrays that cross the SJFZ with typical inter-station distances around 40 m. Pre-processing techniques involving earthquakes removal and whitening on 15 minutes time windows are used to obtained the 9-component correlation tensors associated with all station pairs. The obtained cross correlations exhibit coherent waves up to 30-40 Hz that travel between the station pairs. Polarization and dispersion analysis show that both body and surface waves are reconstructed with Rayleigh group velocity around 500 m/s. The results are likely to include also body waves and trapped fault zone signals. Work on using these data is in progress. Updated results will be presented in the meeting.