3D Anisotropic velocity model of the Los Humeros geothermal field, Mexico, using seismic ambient noise tomography.

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In the framework of the international collaboration between Mexico and Europe for the development of geothermal energy (GEMex consortium), a seismic network of 45 seismic stations (25 broad-band and 20 short-period) was installed around the super-hot geothermal system of Los Humeros (Mexico) for more than one year. Los Humeros power plant is nested inside a quaternary caldera located in the eastern part of the Trans-Mexican Volcanic Belt that crosses the whole country from the Pacific coast to the Gulf of Mexico.

Among the several targets of the data collected by this network, an important task is to produce a seismic image of the caldera and of the geothermal reservoir. Here we present the 3D anisotropic shear wave velocity models retrieved by the seismic ambient noise tomography.

Thanks to the severe pre-processing of the whole seismic database we were able to obtain reliable and highly resolved models.

To carry out the model we applied a rigorous data quality assessment consisting in: 1) correction of the orientation of the sensors using the polarization of surface waves associated with tele-seismic and regional earthquakes, 2) assessment of the synchronization of the stations and correction of the times using daily cross-correlations functions, 3) finally to assess the quality of the stacked cross-correlations, known as Green's functions (GF), we analyzed the noise sources directivity, inter-station distance and level of emergence of surface waves depending on the type of sensor used.

The processing allowed to pick clearly about 600 dispersion curves per velocity type (group and phase of R and L waves), using the NDCP code (Noisy Dispersion Curve Picking), that allows to display and select dispersion patterns both in time and frequency domain, for both causal and anti-causal part of the GF.

2D tomography maps were calculated from 0.5 to 9 s for each type of velocity. Depth inversion for the whole velocities types was carried out using surf96, allowing reconstructing the 3D anisotropic structure of the caldera for the first time.

The resulting models provides a larger view of the caldera and its anisotropic patterns down to 10
km depth. In these models, we were able to define the depth of the caldera rim, some important features of the internal part of the caldera and a low velocity body that could be associated with the hot sources feeding the reservoir. Our model are in strong agreement with those retrieved applying other geophysical methodologies (e.g. magnetotelluric, passive travel-time tomography, gravimetric, etc.).

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