Local earthquake tomography at the Los Humeros geothermal field, Mexico

Tania Toledo\textsuperscript{1,4}, Philippe Jousset\textsuperscript{1}, Emmanuel Gaucher\textsuperscript{2}, Hansruedi Maurer\textsuperscript{3}, Charlotte Krawczyk\textsuperscript{1,4}, Marco Calò\textsuperscript{5}, and Angel Figueroa\textsuperscript{6}

\textsuperscript{1}GFZ German Research Center for Geosciences, Potsdam, Germany (taniat@gfz-potsdam.de)
\textsuperscript{2}Karlsruhe Institute of Technology, Karlsruhe, Germany
\textsuperscript{3}ETH Zürich, Zürich, Switzerland
\textsuperscript{4}TU Berlin, Berlin, Germany
\textsuperscript{5}UNAM, Ciudad de Mexico, Mexico
\textsuperscript{6}Universidad Michoacana de San Nicolás de Hidalgo, Mexico

The GEMex\textsuperscript{*} project is a recently finalized European-Mexican collaboration that aimed to improve the understanding of two geothermal fields: Acoculco and Los Humeros Volcanic Complex. These sites are located in the Trans-Mexican Volcanic Belt, a region that hosts numerous active volcanoes and is favorable for geothermal exploitation. Currently, the Los Humeros Volcanic Complex is one of Mexico’s main geothermal systems with an installed capacity of ~95MW. Many studies have been performed at this site since the 70s highlighting several features and characteristics of the shallow subsurface. However, a thorough knowledge of structures and behavior of the system at greater depths is still quite sparse. Hence one main objective of the GEMex project was to conduct several geological, geochemical, and geophysical experiments to investigate deeper structures for future development of local and regional geothermal resources.

In this framework, for the period of one year (September 2017 to September 2018), a seismic array consisting of 45 seismic stations was set to record continuously at the Los Humeros Volcanic Complex. In this study we analyzed the continuous seismic records to detect the micro-seismicity mainly related to exploitation activities. After applying a recursive STA/LTA detection algorithm, we assembled and manually picked P- and S- phases of a catalog of about 500 local events. The detected events were mostly clustered around injection wells, with fewer events located close to known structures. We use the retrieved catalog to derive a new minimum 1D velocity model for the Los Humeros site. We then performed a joint inversion to obtain the 3D Vp and Vp/Vs structures of the geothermal field. A post-processing averaging of several inversions was also computed to increase resolution of the investigated region. In this study we will show the derived Vp and Vp/Vs models for the Los Humeros Volcanic Complex to emphasize various underground structures and potentially identify possible variations due to changes in temperature, fluid content, and rock porosity.
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 727550 and the Mexican Energy Sustainability Fund CONACYT-SENER, project 2015-04-68074. We thank the Comisión Federal de Electricidad (CFE) for kindly granting the access to the geothermal field for installation and maintenance of seismic stations.