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Structural delineation at the Los Humeros geothermal field, Mexico, by P-wave reflection retrieval from noise

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The overall purpose of the recently finalized GEMex project*, a European-Mexican collaboration, has been to gain an improved understanding of the subsurface at two unconventional geothermal sites: for EGS development at Aocolco and for a superhot resource near Los Humeros. Providing a more precise description of both the geological structure and the geothermal reservoir behavior for these two sites form important requirements for achieving that goal.

For delineating the main structural features at geothermal reservoir level, reflection retrieval from ambient seismic noise can be considered interesting because of its relatively low-cost and low environmental impact as compared to more conventional, controlled-source, seismic surveying practice, where (expensive) active sources are required.

In this study, we present results from the application of ambient noise seismic interferometry (ANSI) to retrieve zero-offset reflected P-waves from continuous seismic data recorded during the second half of 2017 at the Los Humeros geothermal field, Mexico. It is known from noise interferometry theory that reflected P-waves can provide local structural detail at locations directly underneath the employed seismic stations.

We address various data selection and processing aspects related to the retrieval of these reflected P-waves. The reflections are thereafter compared with modelled reflectivities at station locations with sufficient data availability, data quality and proximity to a location at which seismic interval velocity information is available from the literature.

From our study it can be concluded that the ANSI auto-correlation technique that was applied for zero-offset reflectivity retrieval at the Los Humeros site indeed can provide relatively high structural detail: for near-horizontal reflectors in the close vicinity of the selected stations, local depth-estimates of seismic velocity-contrasts were determined. This information can be used to constrain both the geological structure and geothermal reservoir property description.

As such, results from this passive-seismic method may partially complement and partially confirm

subsurface information derived from active-seismic, that can only be acquired at a higher cost, which is more labor-intensive and which has more impact on the environment.

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* http://www.gemex-h2020.eu/index.php?option=com_content&view=featured&Itemid=101&lang=en