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Geothermal exploration in the German Molasse Basin - Supplementary exploration using integrated 3-component data and shear wave measurements

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To establish a dense area-wide network of geothermal facilities, the Stadtwerke München initiated the joint research project GRAME together with the Leibniz Institute for Applied Geophysics (GeoParaMoL*). As a database for the project, a 3D seismic survey was acquired from November 1015 to March 2016 and covers 170 km^2 of the southern part of Munich.

3D seismic exploration is a well-established method to explore geothermal reservoirs, and its value for reservoir characterization of the Malm has been proven by several projects. A particular challenge often is the determination of geophysical parameters for facies interpretation without any borehole information, which is needed for calibration. A new approach to facilitate a reliable interpretation is to include shear waves in the interpretation workflow, which helps to tie down the range of lithological and petrophysical parameters.

Shear wave measurements were conducted during the regular 3D seismic survey in Munich. In a passive experiment, the survey was additionally recorded on 467 single, 3-component (3C), digital receivers that were deployed along one main line (15 km length) and two crosslines (4 km length). In this way another 3D P-wave as well as a 3D shear wave dataset were acquired. In the active shear wave experiment the SHOVER technique (Edelmann, 1981) was applied to directly excite shear waves using standard vertical vibrators. The 3C recordings of both datasets show, in addition to the P-wave reflections on the vertical component, clear shear-wave signals on the horizontal components.

The structural image of the P-waves recorded on the vertical component of the 3C receivers displays clear reflectors within the Molasse Basin down to the Malm and correlates well with the structural image of the regular survey. Taking into account a travel time ratio of 1.6 the reflection patterns of horizontal and vertical components approximately coincide. This indicates that Molasse sediments and the Malm can also be imaged by shear waves. Further processing steps will derive geophysical parameters (e.g. vp/vs) and clarify the amount of converted waves.

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Edelmann, H.A.K. (1981): SHOVER shear-wave generation by vibration orthogonal to the polarization. Geophysical Prospecting 29, 541-549.

* http://www.liag-hannover.de/en/fsp/ge/geoparamol.html