
BGP-T3: Combining seismic with thermal conductivity data for estimating spatial geothermal reservoir properties

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Prediction of rock thermal conductivity in the subsurface is important for the investigation of heat flow and temperature distribution, but it faces economical and technical challenges at large scale. Current measurements of rock thermal conductivity are either based on laboratory measurements on drill cores, outcrop samples or retrieved from borehole temperature logs. Both of them are limited on the location of borehole or outcrops respectively and for boreholes also accompanied with high costs.

To better characterize the natural heterogeneity of geological units, an improved approach to predict the spatial distribution of underground rock thermal conductivity is demonstrated. For this approach, which is based on geophysical in situ data (borehole geophysics and 2D seismic profiles) and lab measurements, ordinary kriging, kriging with an external drift and a Markov model based approach are applied.

Rock thermal conductivity from lab measurements is correlated with seismic velocity. Samples are taken from the Permian Rotliegend of two drill cores in Messel, Germany, which were continuously measured in the lab at a spacing interval of 1 mm. The amount of data sums up to 35,442 data points for dry and 26,045 for water saturated condition.

The dry data set of rock thermal conductivity, where matrix properties have a stronger impact on the bulk value, shows a good linear correlation with seismic velocity as well as porosity from geophysical borehole data both in 1D. Benefitting from the well distributed seismic velocity data in 2D, reasonable estimated results could be adopted by Markov and KED methods at the borehole locations as well as the area covered by the seismic profile. The most reasonable saturated bulk rock thermal conductivity result is presented using the KED method.
