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From seismic to a geothermal model. Seismic assessment of geothermal potential of the Continental Deep Drillhole (KTB) site, Germany

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Renewable energy technologies are becoming increasingly important for the worlds power production. Also the geothermal energy will play a significant role in the future, since it is suitable for the power supply of vast areas, the heat production is time and season invariant and it is environmentally friendly. Presently, the use of geothermal energy for the purpose of electrical power production is still limited by the high investment risks caused by the uncertainties in geothermal reservoir prediction.

The extensive amount of data, which have been gathered during the project: The Continental Deep Drillhole (KTB) in the South German crystalline, offer a wide database of information concerning the continental earth crust. Temperatures of 265°C which have been measured at the final depth of 9101m in the KTB drill hole, make the site a geothermaly interesting area. It became one of the sites, which have been analysed within the project MeProRisk, a project to for evaluating and reducing risks in exploration, development, and operation of geothermal reservoirs. With the aim to provide a better characteristic of a potential geothermal reservoir, 3D reflection seismic measurements and borehole logs have been taken as the basis for the thermal and hydraulic studies. To be able to identify the complex network of fractures and faults which can be found in the crystalline rock and can work as possible fluid paths, improved processing methods had to be applied to the 3D seismic dataset.

The dominant fault zone, which is crossing the area in the NW-SE direction and is dividing it into two main blocks, the so called SE1 reflector, is itself seen as a seismic event in the seismic data. This big scale fault was isolated from the dataset with combined dip and envelope calculations. Application of log-Gabor filters and the following skeletonization lead to good results in the extraction of the vast small scale crack inventory of the crystalline rock. The whole dataset has also been divided into rock units, in order to construct a structural model of the KTB site. Each rock unit received 13 initial petrophysical properties as density, thermal conductivity, and heat generation rate. Zones with high and low porosity and permeability have been identified independently on the rock units with the help of crack density calculations and have also been implemented into the structural model.

All petrophysical properties are derived from combined interpretation of log data and core measurements.

Calculations of synthetic seismograms and fractal dimensions verify the structural model and quantify its reliability. The final model is used as the input in thermal and hydraulic simulations, of which the preliminary results will be presented on the poster.