The geothermal well “RWTH-1” was drilled for the purpose of heating and cooling the future student service centre “SuperC” at Aachen University. Notwithstanding the economic character of this EU-funded deep borehole (TD at 2544 m), a comprehensive geoscientific research program funded by the DFG is aimed at providing new information from this geologically crucial area. Aachen is located at the transition between the Variscan front and the Lower Rhine Embayment. The area is seismically and hydrothermally active which is related to the prolonged structural evolution characterized by compression and extension. Five projects related to the RWTH-1 borehole are currently funded by the Deutsche Forschungsgemeinschaft (DFG). The recent and palaeo stress field as well as the geothermal, fluid and material transport processes now and in the past are in the focus of interest.

### In-situ stress, microtectonics and rock-fluid-interactions in a seismic and hydrothermal active area of crustal extension

The location is affected by strong tectonic stresses now and in the past. Faults and fractures are the evidences for the recent and palaeo stress system. The analysis of structural data suggests that the present stress pattern is different from the past. The study of stress-time series indicates a complex deformation history. The micro-structural investigation of thin sections has revealed that extensional, compressional as well as shear-movements occur. The veins indicate four different vein generations and allow the distinction between burial induced high pressure pore fluid formation and variscan compression events. A few open fractures/faults (at least at the borehole wall) are detected. These are assumed to be formed in the recent stress field. The recent stress regime was investigated by analysis of stress related structures formed during the drilling process. Compressive borehole breccias and tensile fractures at the borehole wall show the orientation of the maximum principal horizontal stress to be NW-SE (135°). Combined with rock mechanics data they indicate a little slip faulting regime at present.

### Palaeofluids in hydrothermal veins and intergranular cements of the Aachen geothermal well „RWTH-1“

Fluids play an important role in the evolution of the crust as they transport heat and materials, induce mineral reactions, control diagenesis, metamorphism and hydrothermal veining. Relicts of these fluids may still exist in the form of fluid inclusions. We found that very hot waters from deeper crustal levels rise and led to the sealing of the flow paths.

Due to petrological and microthermometric analyses these different fluid systems can be characterised. Microthermometry shows the expulsion of three main hydrothermal fluid types. Therefore the hydrothermal fluid flow was controlled by seismic pumping. High shear stresses are indicated by cataclasites.

### Radiogenic isotope systems in microstructures and their implications for the development of a fluid system

Within rocks and veins the distribution of mobile elements (e.g. R, see figure) as well as radiogenic isotope signatures indicates pathways and sources of hydrothermal fluids. In addition to the well-characterised fluid zone in the first core section, the data bring out a second major zone affected by hydrothermal fluid flow in the second section between 1600 and 2000 m. This is in line with the abundance of fractures in the drift hole (see figure). Low silica and dolomite “crystalinity” reveal a short term hydrothermal event.

### Geothermal modeling of the Aachen region and calibration of the coaxial downhole heat exchanger

The physical properties of the Carboniferous and Devonian rocks drilled in the RWTH-1 borehole were determined from logging data and calibrated by core measurements. They were used for design calculations of the SuperC borehole heat exchanger and for the construction of a large regional 3D heat flow model (40 x 40 x 5.5 m) of the Aachen region (Fig. 4a).

A new designed, fast and effective formulation of an arbitrary coaxial downhole heat exchanger (Fig. 4b) can be flexibly placed into the regional 3D finite difference model, giving the outlet temperature (°C) and the thermal power (kW). Doing this for every grid node of the 3D model enables us to create prognosis maps (Fig. 4c) of the region, which indicates the optimal locations to place borehole heat exchangers.

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**References**


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