Technology for the Utilization of Deep Geothermal Reservoirs in Germany

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Technológie pre zužitkovanie hlbokých geotermálnych rezervoárov v Nemecku

The Geothermal Technology Program at GFZ identify suitable geological structures and horizons for extracting energy and develop new methods to increase the productivity of deep geothermal reservoirs. In this context, the former gas exploration well Groß Schönebeck EGrSk3/90 (50 km northeast of Berlin) was reopened and deepened to the 4309 m depth to serve as a geothermal in situ laboratory for testing stimulation concepts. The objective of these stimulation operations was to create secondary flow paths and to improve the inflow performance of the well.

In addition, Groß Schönebeck is the only test site of the EU-project I-GET (Integrated Geophysical Exploration Technologies for deep fractured geothermal systems), where new, cost-effective and reliable geothermal exploration techniques are developed to increase the success rate of drilling.

Based on the data of deep neighbouring wells and the industry seismic measurements, a model was generated to visualise the geological setting and to plan the course of the second well. The well encounters a typical sequence of various geological formations, known in the North German Basin. A series of 2370 m of Quaternary to Triassic sediments is underlain by 1492 m of Zechstein salts, and the following section of this well, which was foreseen for testing, comprises 400 m of Rotliegend formation (siltstones, sandstones, conglomerates and 60 m of underlying volcanic rocks) down to the final depth of 4309 m.

The well Groß Schönebeck makes the deep sedimentary Rotliegend reservoir accessible, which is characterized by water bearing porous and fractured rocks. The Rotliegend reservoir consists of a sequence of sandstones, conglomerates, and volcanic rocks with formation fluids of 150 °C at porosities of up to 10 %. Experiments in this in-situ geothermal laboratory should lead to a reliable technology for a sufficient production of deep fluids in such reservoirs.

Key words*: Utilization of Deep Geothermal Reservoirs, water bearing porous and fractured rocks*

Since 2002, a series of hydraulic stimulation procedures were carried out.

The proppant-gel-frac techniques as well as the waterfrac techniques were used in several different experiments. Recent data of a production test shortly after the massive injection show a productivity index of 14 m 3 h-1MPa-1 at a pressure corresponding to the open fracture. This productivity index seems to be sufficient for a geothermal power production.

During the stimulation experiments, fluids under a high pressure penetrate into the rock and generate or extend fractures. Hydrothermal reservoirs require a special stimulation technique to be able to produce considerably higher amounts of fluids compared to hydrocarbon reservoirs. In contrast to the HDR technology the aim of the experiments is not to install a heat exchanger but to get access to formation fluids in the reservoir. The most important parameters in these experiments include the fluid volume in the fractures, the injection rate, the viscosity (water with added polymers), the composition (chemical variants) or adding proppants) and the selection of the depth interval to initiate new fractures.

The concept for a power production from the Groß Schönebeck reservoir comprises a doublet of wells. The second well should be completed as a production well, the existing well can be used as an injection well.

After completing the second well, a next step will be the development of a long-term circulation experiment to demonstrate the sustainability of the reservoir. In case of a success a demonstration power plant will be installed in cooperation with an industrial partner. This plant shall demonstrate that appropriate technologies can generate the electrical power from deep sediments as a reliable, environmentally friendly renewable source of energy.

The long-term objective of the geothermal research activities is a development of reliable methods to increase fluid productivity of geothermal reservoirs and the examination of measures for the long-term and cost-effective extraction of the energy. It also includes the development of process technology for the effective installation of geothermal power plants, and for optimizing the operation of all aspects of the system. The effective long-term and cost-effective extraction of energy is of special interest. This must be a accompanied by detailed monitoring of processes and components of the plant at the surface to enable a continuous fine tuning of the system as well as an optimization of the technologies involved.

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