Geophysical Research Abstracts
Vol. 14, EGU2012-4181, 2012
EGU General Assembly 2012

Regional geothermal 3D modelling in Denmark

S. E. Poulsen, N. Balling, T. S. Bording, and S. B. Nielsen
Department of Earth Sciences, Aarhus University, Aarhus, Denmark (soeren.erbs@geo.au.dk)

In the pursuit of sustainable and low carbon emission energy sources, increased global attention has been given to the exploration and exploitation of geothermal resources within recent decades. In 2009 a national multi-disciplinary geothermal research project was established. As a significant part of this project, 3D temperature modelling is to be carried out, with special emphasis on temperatures of potential geothermal reservoirs in the Danish area. The Danish subsurface encompasses low enthalpy geothermal reservoirs of mainly Triassic and Jurassic age. Geothermal plants at Amager (Copenhagen) and Thisted (Northern Jutland) have the capacity of supplying the district heating network with up to 14 MW and 7 MW, respectively, by withdrawing warm pore water from the Gassum (Lower Jurassic/Upper Triassic) and Bunter (Lower Triassic) sandstone reservoirs, respectively. Explorative studies of the subsurface temperature regime typically are based on a combination of observations and modelling. In this study, the open-source groundwater modelling code MODFLOW is modified to simulate the subsurface temperature distribution in three dimensions by taking advantage of the mathematical similarity between saturated groundwater flow (Darcy flow) and heat conduction. A numerical model of the subsurface geology in Denmark is built and parameterized from lithological information derived from joint interpretation of seismic surveys and borehole information. Boundary conditions are constructed from knowledge about the heat flow from the Earth's interior and the shallow ground temperature. Matrix thermal conductivities have been estimated from analysis of high-resolution temperature logs measured in deep wells and porosity-depth relations are included using interpreted main lithologies. The model takes into account the dependency of temperature and pressure on thermal conductivity. Moreover, a transient model based correction of the paleoclimatic thermal disturbance caused by the Weichselian glaciation is included in the model procedure. The ability of MODFLOW for simulating heat conduction is demonstrated in simple test cases. The regional geothermal model is then utilized for modelling the subsurface temperature distribution and contouring updated temperature maps for geothermal reservoirs in Denmark.