GeotIS - a Geothermal Information System for Germany

Thorsten Agemar

J.-A. Alten, J. Brunken, M. Heber,
J. Kuder, K. Kühne, A.-A. Maul,
S. Pester, K. Schönhofen, W. Wirth &
R. Schulz

GeoFund Workshop on Geological Risk Insurance
Karlsruhe, November 11th 2008
Outline

- Geothermal energy in Germany
- Project
- Catalogue of geothermal installations
- GeotIS – geothermal resources in Germany
  - Spatial scope
  - Data sources
  - User interface
  - Technical concept
<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Temperature Range</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near-surface Geothermal Energy</td>
<td>10 - 20°C</td>
<td>Heating (requires heat pump)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cooling</td>
</tr>
<tr>
<td>Hydrogeothermal Energy</td>
<td>20 - 150°C</td>
<td>District Heating</td>
</tr>
<tr>
<td>Deep Aquifers</td>
<td></td>
<td>Power Generation (&gt;100°C)</td>
</tr>
<tr>
<td>Petrothermal Energy</td>
<td>&gt;150°C</td>
<td>Power Generation</td>
</tr>
<tr>
<td>Enhanced Geothermal Systems Bedrocks</td>
<td></td>
<td>District Heating</td>
</tr>
</tbody>
</table>
# Geothermal Information Systems in Germany

16 Federal States = 16 Geological Surveys

<table>
<thead>
<tr>
<th></th>
<th>Medium</th>
<th>NEAR-SURFACE GEOTHERMY</th>
<th>DEEP GEOTHERMY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baden-Württemberg</td>
<td>Internet</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Bavaria</td>
<td>CD/DVD</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Brandenburg</td>
<td>Internet</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Lower Saxony</td>
<td>Internet</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Mecklenburg-Vorpommern</td>
<td>Internet</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>North Rhine-Westphalia</td>
<td>CD</td>
<td>●</td>
<td></td>
</tr>
</tbody>
</table>
Deep Geothermy in Germany

• 2004: Renewable Energy Act
  – 15 ct/kWh for geothermal electricity

• 2008: Revision of Renewable Energy Law
  – 16 ct/kWh for geothermal electricity
  – Plus 4 ct/kWh for power plants with start of operation until 2015
  – Plus 3 ct/kWh for cogeneration of heat and power
  – Plus 4 ct/kWh for enhanced geothermal systems

• Technical developments
  – Seismic
  – Drilling
  – Frac process
  – . . .

• Development of insurances covering exploration risk
• Development of a geothermal information system
Exploration Risk

The exploration risk is the risk of penetrating a geothermal reservoir with one (or more) borehole(s) with inadequate quantity or quality.

- Quantity is defined by the installed output:

  \[ P = \rho_F c_F Q \left(T_i - T_o\right) \]

- Quality is determined by the composition of the fluid
An internet-based atlas of hydrogeothermal resources in Germany

- Catalogue of geothermal installations
- Compilation of all relevant subsurface parameters
  - Occurrence, thickness and depth level of aquifers
  - Faults
  - Hydraulic data
  - Temperatures
  - Well data
- Web Map Service and more
  - UMN-Mapserver
  - Java-Servlets for user-defined views
  - Box whisker plots for hydraulic data
Project

Funding: German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU)

Partners: FU Hydrogeology Section, Berlin
          GTN Geothermie Neubrandenburg GmbH
          LBEG Lower Saxony, Hannover
          LfU Bavaria, Augsburg
          LUNG Mecklenburg-Vorpommern, Güstrow
          RPF Department of Environment, Freiburg

Scientific steering: Deep Geothermy Work Group of the geological surveys (PK Tiefe Geothermie)
Catalogue of Geothermal Installations (VGS)

http://www.geotis.de/vgs

- data compilation by “PK Tiefe Geothermie“
- interactive maps (UMN-Mapserver)
  - location specific data (e.g. flow rate, temperature, use ...)
  - permission fields
  - various map backgrounds (e.g. topography ...)
- integrated community index
- federal state selection mode
<table>
<thead>
<tr>
<th>Name</th>
<th>Hauptnutzung, Nebennutzung</th>
<th>Temperatur °C [max.]</th>
<th>Fließrate l/s [max.]</th>
<th>Teufe m [max.]</th>
<th>Lage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dürnhaar</td>
<td>Strom., ·</td>
<td>kein Wert</td>
<td>kein Wert</td>
<td>kein Wert</td>
<td>zoom</td>
</tr>
<tr>
<td>Erding</td>
<td>Fem., Thermal.</td>
<td>66</td>
<td>kein Wert</td>
<td>2200</td>
<td>zoom</td>
</tr>
<tr>
<td>Kirchstokach</td>
<td>Strom., ·</td>
<td>kein Wert</td>
<td>kein Wert</td>
<td>3750</td>
<td>zoom</td>
</tr>
<tr>
<td>München Riem</td>
<td>Fem., ·</td>
<td>94,3</td>
<td>64,4</td>
<td>2746,7</td>
<td>zoom</td>
</tr>
<tr>
<td>Pullach</td>
<td>Fem., ·</td>
<td>107</td>
<td>40</td>
<td>3446</td>
<td>zoom</td>
</tr>
<tr>
<td>Unterhaching Gt 1/1a</td>
<td>Fem., Strom.</td>
<td>122</td>
<td>kein Wert</td>
<td>kein Wert</td>
<td>zoom</td>
</tr>
<tr>
<td>Unterschleißheim</td>
<td>Fem., ·</td>
<td>81</td>
<td>90</td>
<td>1960</td>
<td>zoom</td>
</tr>
</tbody>
</table>

**Legende**

Standorte
- + Standorte mit Nebennutzung
  - Stromerzeugung
  - Fernwärme
  - Gebäudeheizung
  - Thermalbad / Balneologie
  - Trink- / Brauchwasser
  - CO₂-Gewinnung
  - Forschung
  - sonstige
  - ungenutzt
Hydrogeothermal Resources

- North German Basin
  - Aquifer Complex Lias-Rhaetian
  - Middle Bunter Sandstone
  - Rotliegend Sandstone
  - Lower Cretaceous Sandstone
  - Dogger Sandstone
  - Keuper Sandstone
- Upper Rhine Graben
  - Upper Muschelkalk
  - Middle Bunter Sandstone
- Southern German Molasse Basin
  - Upper Jurassic (Malm)
Data Sources

Well Data: Hydrocarbon exploration (ca. 27,000)
Geothermy
Mining
Water

Hydraulics: Hydrocarbon Information System, LBEG
Datasets of partners

Temperatures: Geophysical Information System, GGA
(ca. 9,500 locations)

Structural Data: Maps of geothermal resources (NE-Germany)
Maps of Malm depth level (Molasse Basin)
Geological cross sections:
  - Western Molasse Basin
  - Upper Rhine Valley
User Interface: Map Navigation
User Interface: Box Whisker Plot of Hydraulic Data

Retrieve mean values for porosity or permeability.
Use your mouse to draw a line on the map . . .

explore the deep underground on a geologic cross section . . .

and save all as one PDF-file!
User Interface: Temperature + Well Locations

Get temperature distribution at any depth level between 0 and -5000 m NN.

-2300 m NN constant depth level
User Interface: Temperature + Well Locations

Get temperature distribution at any depth level between 0 and -5000 m NN.

-4500 m NN constant depth level
User Interface: Stratigraphy + Temperature

Lias (Base)
depth level & temperature
Thank you!