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Cross border 3D modelling

challenges and results of a transnational geothermal project

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TransGeoTherm project

The TransGeoTherm is a common project of the Polish Geological Institute (PGI) and the Saxon Geological Survey (LfULG). It was co-financed by the European Union (EU) within the framework of the Operational Programme for Transboundary Cooperation Poland-Saxony 2007-2013. The project started in October 2012 and was completed in December 2014.

The realisation of TransGeoTherm is based on innovative methods **analysing and interpreting geological, hydrogeological and geothermal data** with respect to 3D modelling processed using the software package SKUA-GOCAD.

main objectives of the project

- to initiate and establish the use of **low temperature geothermal energy** in the Saxon-Polish boundary region,
- to combine and **process heterogeneous geoscientific data** from both geological institutes,
- to perform a **3D subsurface model** of the whole project area as source for 3D numerical simulations,
- to establish a 3D geodata infrastructure using a **3D database**
- to generate **geothermal maps**

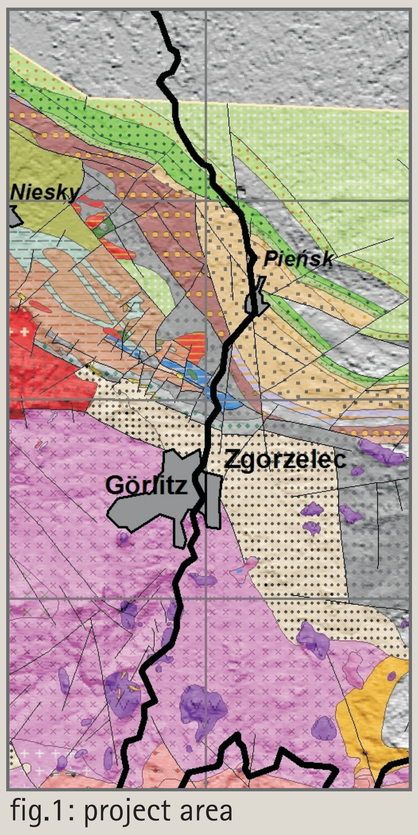

fig.1: project area

Data preparation

As a first step all available geoscientific data was analysed and homogenised. After the evaluation of geological maps, printed reports and borehole documentations a set of **76 lithostratigraphic units** was defined. Digital geological maps in different scales were used as constraints for the 3D model. Some problems occurred while combining these data with the high-resolution digital elevation model (DEM) as well after a coordinate transformation.

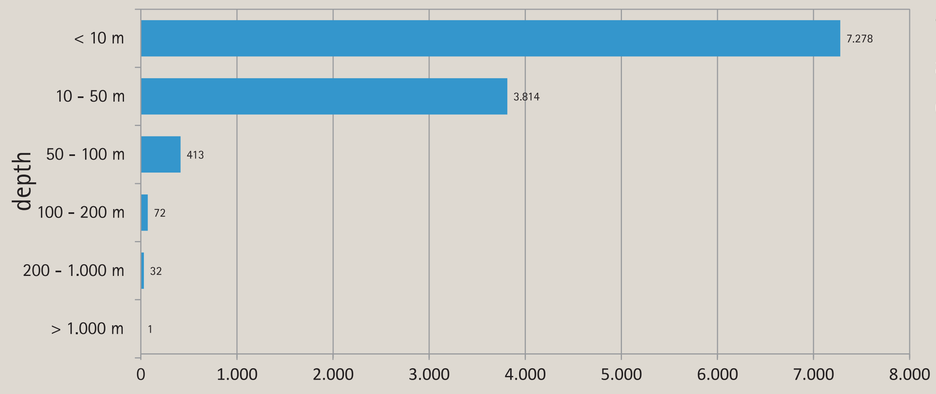

fig.2: depth and number of boreholes

Information about subsurface geology was mainly obtained from **11.600 boreholes** in the German part and only **1.250 boreholes** in Poland (most of the boreholes **not deeper than 50 m)**. About 500 boreholes 50 to 1.000 m deep allowed the prediction of the deeper geological structures. Numerous digital map data, fault-lines and cross sections were also used as input data. The different scales, age and content of this data proved to be problematic.

3D modelling using SKUA-GOCAD

The structural 3D subsurface model of the project area was created within the software Paradigm SKUA-GOCAD. Since the investigation territory encompasses 650 km² the 3D modelling was performed by various team members in several sub areas.

Cenozoic and pre-Tertiary units were modelled separately. A consistent approach from bottom to top would have made fewer problems afterwards. Due to the variety of stratigraphic units, modelling of the Quaternary was the most time-consuming step.

After processing all data within GOCAD, the results had to match the data-structure in the existing hydrogeological database. Therefore the triangulation of the surfaces was normalized by a so called master grid with a 25 m spacing. All attributes of the object are then stored cell-centered.

modelling process

- creation of horizon boundaries in 2D,
- construction of artificial constraints, honouring the locally measured layer thickness and the spatial distribution of borehole data,
- geostatistical interpolation of layer thickness and base heights,
- construction of the volume model based on base layers and layer thickness,
- conversion to a regular grid.

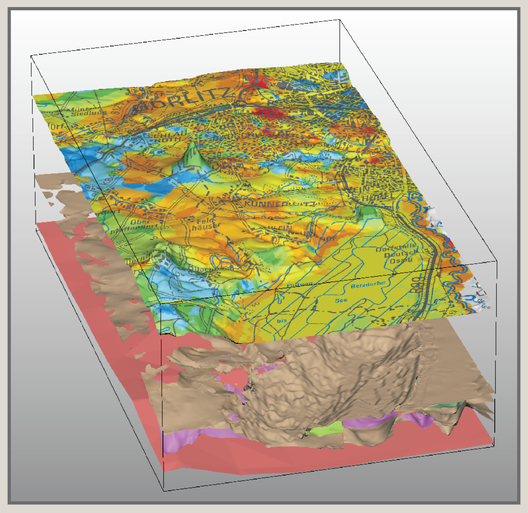

fig.3: part of the final 3D-model; DEM colour-coded with geothermal heat extraction rate

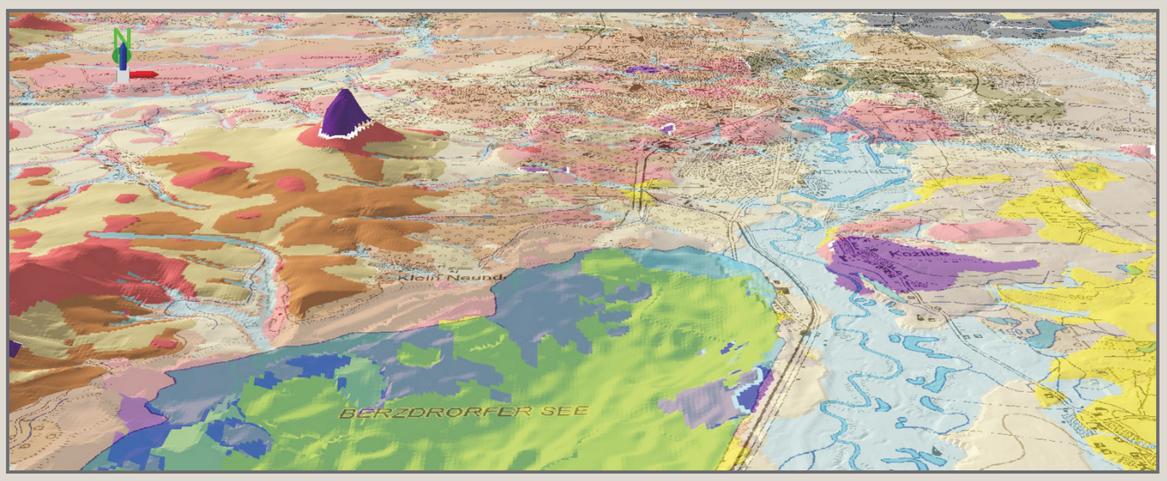

fig.4: final geological model of the Berzdorf region

Conclusion

Based on all available data a detailed 3-dimensional geological model was created in the TransGeoTherm project area. Some problems and challenges occurred during the process of data preparation and modelling. Mostly a lack of interoperability of input data and data structures caused inhomogeneities in the intermediate results.

With help of a 3D database approach the final data could be stored consistently and made available for further projects. The derived information (3D model and geothermal maps) is issued via a public web portal.

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