# Building a Complex Geological Model Using Parametric Surfaces

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## Abstract

Introduction: In general, sedimentary basins show high potential for the use of geothermal energy. Since the Vienna Basin is a densely populated area (approximately 1.7 million people in the city of Vienna plus surroundings), geothermal power and heat could play a significant role in the future. The Vienna Basin shows moderate geothermal conditions as the 100 °C isotherm is to be found at a minimum depth of about 2500 meters. This fact, meaning the need of deep thus expensive wells, adding the problem of space for drilling and geothermal power plants, are challenging subjects in terms of exploitation of this natural resource. Temperature measurements of the subsurface are available due to hydrocarbon exploration in the project area, where the average drilling depth is about 2-4 km and the deepest well reaches about 8.5 km. Since the data is heavily uneven distributed, standard interpolation techniques did not deliver satisfying results. This is why numerical modeling was applied to assess the thermal regime of the deeper structural levels of the basin. In the first phase a geological 3D model was created using published data (surface geology from interpreted cross sections resulting drilling and seismic data) as well as markers from selected wells (data derived from the OMV). The geometrical model was built in GoCADTM where from the major surfaces had been exported as point sets: these were used as input for creating parametric surfaces in the COMSOL environment. Use of COMSOL Multiphysics: On the basis of these surfaces the model block could be divided into five subdomains. The internal structure of the Alpine basement was too complex to be set up geometrically in COMSOL, so the material parameters of this subdomain were assigned using 3D interpolation functions (Figure 1). Since deep aquifers in the northern Vienna Basin are supposed to remain static, groundwater flow was not modeled. Nevertheless, the Subsurface Flow Module was used for thermal modeling of heat transfer in porous media because it offers more possibilities than COMSOL Multiphysics alone. At the base of the model block a Neumann Boundary was set (constant heat flux), while the topography represents a Dirichlet Boundary (altitude-dependent surface temperature). Comparisons between modeled and measured temperature data from deep drilling has been used for calibration of the material parameters and validation of the model (Figure 2). Results: The major results of this work are compiled temperature maps in specific depths respectively superimposed on selected surfaces and maps of isotherms at certain levels (Figure 3). The next phase of the project deals with modeling of two exploitation scenarios in different hydrological systems to assess geothermal resource quantification (e.g. recoverable heat in place).

## Figures used in the abstract

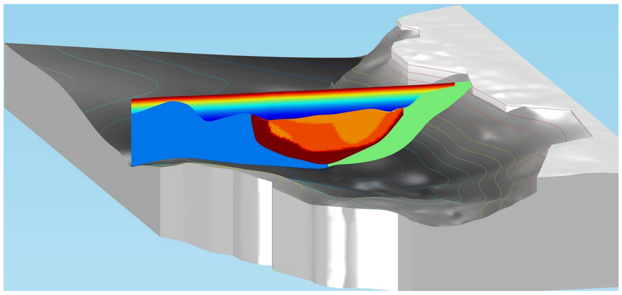

**Figure 1**: View into the basin from SW with a NW-SE section across the model area, the greyscale surface represents the top of the crystalline basement, the cross section shows the variation of material parameters within the model.

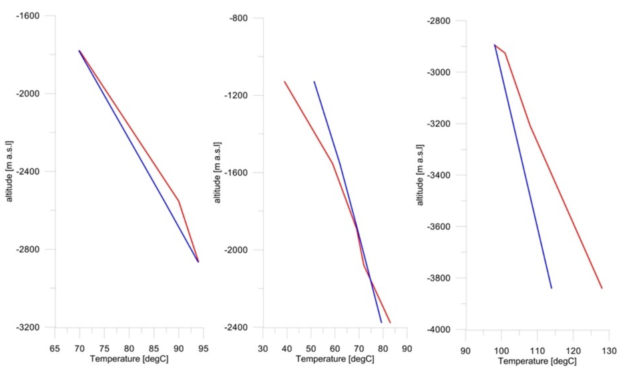


**Figure 2**: Comparison of measured (red) and modelled (blue) Temperature profiles. Analysis of the deviations allows fine-tuning of the model parameters.

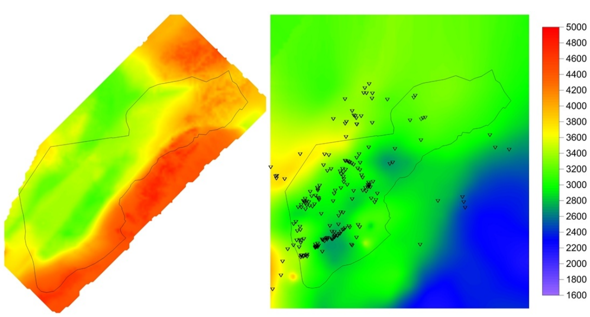


**Figure 3**