Establishing a 3D model for the Rhine-Ruhr region based on the geology and property distribution.

Gabriela de los Angeles Gonzalez de Lucio\textsuperscript{1,2}, Martin Balcewicz\textsuperscript{1,3}, and Erik H. Saenger\textsuperscript{1,2,3}

\textsuperscript{1}Civil and Environmental Engineering, Bochum University of Applied Sciences, Bochum, Germany
\textsuperscript{2}Fraunhofer Institute for Energy Infrastructures and Geothermal Energy, IEG, Bochum, Germany
\textsuperscript{3}Institute of Geology, Mineralogy and Geophysics, Ruhr-Universität, Bochum, Germany

The Rhine-Ruhr region is located in the state of North Rhine-Westphalia (NRW) in western Germany. Due to the transition from coal to low-carbon heat sources, potential locations in NRW must be explored regarding their geothermal potential. The Bavarian area has shown for the last 20 years, that deep geothermal energy is both feasible and economical in Germany. Compared to the mentioned Molasse basin in south Germany, the geological setting is much more complex in the Rhine-Ruhr region. Based on a typical geothermal gradient of 30 °C/km, the optimal depth of a reservoir should be between 3000 m to 5000 m. In this depth, carbonate layers from Devonian times were identified in NRW. Due to the lack of accessibility, minor reservoir characterization was done, yet. Therefore, a geological model which reflects local lithological properties is essential for further geothermal projects. The model of the Rhine-Ruhr region is based on field surveys, top formations, geological sections and maps, respectively. The geometrical model is supplemented by rock properties, like density, porosity, and P- respectively S- wave velocities. These properties are derived from well logs, laboratory measurements and literature, transferring the derived properties to the grid require an analysis of upscaling techniques and distribution of such properties in the model. The result is a heterogeneous model representing the geological structure and rock property distribution of the Rhine-Ruhr region. Representative lithological units like Ruhrsandstone or interbedded coal, clay, and sandstone strata are also implemented as dominant fracture orientations. In this work we are considering several parameters to find a balance between the resolution of the model, property scaling and computational efficiency. One key aspect is that geological models are built with irregular grids while for our wave propagation simulations a regular and cartesian grid with equal grid spacing is required. Of course, such regular grids can be used for several modelling techniques and can be used as a basis for different studies. Overall goal is to evaluate local geological models to assess the feasibility of geothermal projects in the area.