Numerical Modelling of the Stress Field in the Hanover Area

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The North German Basin (NGB) is characterized by complex geological structures consisting of faults and salt bodies, which impact the subsurface stresses, pore pressure and temperature. Understanding these perturbations is essential for successful hydrocarbon exploration, geothermal energy extraction, and underground storage operations. This study investigates the area close to the city of Hanover between the salt diapirs Benthe, Lehrte, Hope and Wietze-Hambuehren, where Eavor GmbH is planning a closed-loop geothermal system.

Our research employs an advanced geomechanical model that simulates the relaxation of the above-mentioned salt diapirs and the corresponding redistribution of stresses, pore pressure and temperature. The geomechanical model is set up in the software package COMSOL Multiphysics, which is based on the Finite Element Method, and incorporates detailed geological features. Relaxation of a salt body naturally occurs when the deviatoric stresses within it, initially induced by a purely gravitational stress field, start diminishing. The model is calibrated against offset well data confirming an overall normal faulting stress regime at larger distances from the salt diapirs. However, significant stress alterations can be observed closer to the salt diapirs, highlighting the strong influence of salt structures on the stress field in the NGB. This explains the frequent occurrence of drilling problems in the vicinity of salt bodies (e.g. local stress regime change from normal to strike slip faulting depending on the position relative to the salt dome). The model will be used at a later stage to extract geomechanical properties along the proposed geothermal well paths to analyze optimal directional plans and drilling parameters.