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The Wiesbaden geothermal project as example for an integrated approach to exploration in an urban area

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The Upper Rhine Graben (URG) is one of the major geothermal exploration targets in Germany and France due to its elevated geothermal heat flux. So far exploration mainly focused on the URG itself. However, indicators for geothermal activity can also be found outside the Graben in its direct western vicinity along the southern rim of the Taunus Mountains which mark the northern margin of the variscan Saar-Nahe-Basin (SNB). The area is tectonically active and fault bound outflowing hot fluids with temperatures >60°C point towards an active geothermal system in the deeper underground of the city of Wiesbaden. In contrast to the URG the Wiesbaden area was so far no target for any geophysical prospecting. However, the city of Wiesbaden together with the local power supplier decided to explore the potential of a deep geothermal reservoir within the SNB suitable for power production.

We present geophysical exploration data revealing the local geometry and internal structure of a potential geothermal reservoir near Wiesbaden. Our studies encompass LIDAR analyses, a dense gravity and magnetic survey as well as 2D and 3D seismic surveys and seismological observations. Combining the applied methods sediment thicknesses of c. 4000m and some deep reaching active faults can be constrained which we address as most suitable drilling targets. As the area is densely populated a major focus in our exploration concept was to define those faults as drilling targets which have a low risk of being reactivated by changing pore pressures during production while still offering high permeability values. To investigate the reactivation potential of the identified faults we used geomechanical models simulating the local stress field acting on the faults. Ensemble models helped to estimate uncertainties in the models caused by limited data availability. Finally, the acquired data form the basis for a seismic risk assessment. We give a critical evaluation of the applied exploration techniques in densely populated areas.