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Hydrothermal simulation of a fractured carbonate reservoir in southern Italy and automated detections of optimal positions for geothermal doublet installations

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In this work, we present the results of hydrothermal simulations for assessing the geothermal potential of a fractured carbonate reservoir in Campania (Guardia Lombardi). Local surface heat flows of up to 90 mW/m^2 suggest that this area is a potential medium-enthalpy geothermal reservoir.

The targeted reservoir rocks are fractured shallow-water carbonates (Jurassic to Cretaceous) of the Apulia Platform. During the Apennine orogeny, those carbonates were affected by at least two tectonic phases: Thrust-related folding of the carbonate platform due to compression followed by extension which caused major normal faulting.
Based on seismic interpretation, a discretized structural model is set up, comprising the reservoir unit and the overlying sedimentary cover. The model comprises an area of 42 km $\times$ 28 km and extends to a depth of about six kilometers. Results of calibrated hydrothermal reservoir simulations suggest that free convection occurs in some parts of the reservoir.

For assessing optimal locations for potential hydrothermal doublet systems, a tool was developed which uses the results of the reservoir simulationsin combination with predefined constraints. Those constraints or minimum requirements consider: a) minimum temperature for operating the doublet system, b) minimum matrix permeability allowing for a pumping rate of 40 L/s, and c) social constraints (location of cities or conservation areas, where the construction of a potential geothermal energy plant would be problematic). The optimization tool ranks possible doublet system locations by evaluating an objective function for the minimum requirements. Those locations are further used to extract smaller models from the big reservoir model and simulate the operation of a hypothetical geothermal doublet system.

By assessing the optimized results, an optimal location of a geothermal energy plant would produce water with a temperature of 163 °C from a depth of almost 4 km.