

From conceptual to numerical model: the example of the Euganean Geothermal System (NE, Italy)

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The Euganean Geothermal Field (EGF) extends on a plain band to the south-west of Padua (NE Italy). Approximately $14 \cdot 10^6$ m³/y of thermal water with temperature from 65°C to 86°C are exploited from different, 300-1000 m deep, fractured rock aquifers located within Mesozoic carbonate formations. The EGF represents the outflow area of a regional, 100 km-long, hydrothermal system. Oxygen isotopic analysis evidences the meteoric origin of the water that infiltrates at approximately 1500 m a.s.l. in the Veneto Prealps. The water flows towards the South in the Mesozoic carbonate formations and reaches a depth of approximately 3000 m warming to 100°C due to the normal geothermal gradient. The regional Schio-Vicenza fault systems and its highly permeable damage zone increase the water flow. In the EGF area, an interaction zone between the segments of the fault system and the related extensional tectonic regime produce a local fracture network that enhances the permeability and the quick rising of the thermal water.

The conceptual model of the thermal system is reproduced in a 3D numerical model using FEFLOW code with the aim of understanding the influence of the fault system and its damage zone on the thermal water flow. The numerical simulation is based on the Equivalent Porous Medium Approach (EPM), while the geological setting is implemented using a simplified, planar stratigraphic sequence made by 3, 1400 m thick, layers (*isotropic permeability*: $k_1 = 1 \cdot 10^{-9}$ m/s, $k_2 = 1 \cdot 10^{-6}$ m/s, $k_3 = 1 \cdot 10^{-11}$ m/s; *thermal conductivity*: $c_1 = 2.1$ W/m*K; $c_2 = 3.1$ W/m*K; $c_3 = 3.25$ W/m*K) and increasing the permeability of both the damage zone and the interaction zone by 2 orders of magnitude. The result evidences the development of convective cells along the damage zone of the faults and the local increase of the temperature in the subsurface of the EGF up to 110°C, comparable with the temperature of the Euganean thermal water. Further simulations will be carried out refining the geological model up to 8 layers, which represent the complete stratigraphic sequence involved in the thermal system. In addition, the influence of fault system on the development of the convective cells will be unraveled testing different width of the damage zone and different permeability ratios between the protolith and the damage zone.