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Revisiting the Euganean Geothermal System (NE Italy) – insights from large scale hydrothermal modelling

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As one of the largest and most extensive utilized geothermal system in northern Italy, the Euganean Geothermal System (EGS, Veneto region, NE Italy) has long been the subject of still ongoing studies. Hydrothermal waters feeding the system are of meteoric origin and infiltrate in the Veneto Prealps, to the north of the main geothermal area. The waters circulate for approximately 100 km in the subsurface of the central Veneto, outflowing with temperatures from 65°C to 86°C to the southwest near the cities of Abano Terme and Montegrotto Terme. The naturally emerging waters are mainly used for balneotherapeutic purposes, forming the famous Euganean spa district. This preferential outflow is thought to have a relevant structural component producing a high secondary permeability localized within an area of limited extent (approx. 25 km2). This peculiar structure is associated with a local network of fractures resulting from transtentional tectonics of the regional Schio-Vicenza fault system (SVFS) bounding the Euganean Geothermal Field (EGF). In the present study, a revised conceptual hydrothermal model for the EGS based on the regional hydrogeology and structural geology is proposed. Particularly, this work aims to quantify: (1) the role of the regional SVFS, and (2) the impact of the high density local fractures mesh beneath the EGF on the regional-to-local groundwater flow circulation at depths and its thermal configuration. 3D coupled flow and heat transport numerical simulations inspired by the newly developed conceptual model are carried out to properly quantify the results from these interactions. Consistently with the observations, the obtained results provide indication for temperatures in the EGF reservoir being higher than in the surrounding areas, despite a uniform basal regional crustal heat inflow. In addition, they point to the presence of a structural causative process for the localized outflow, in which deep-seated groundwater is preferentially conducted to the surface, warming up on its way, by the high level of connected fractures beneath the EGF, thus corroborating the proposed conceptual model.