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Determination of geometrical parameters of fractures in Triassic dolomites: the case study of the Daruvar Hydrothermal System (Croatia)

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Carbonates extend on approximately 15% of the ice-free land surface, and approximately 16% of the global population lives in karst areas depending on its groundwater resources. The estimation of the permeability field in carbonate aquifers is crucial for their sustainable management. The presented research was conducted in the Daruvar hydrothermal system (DHS) in the north-eastern part of the Republic of Croatia. It is a typical hydrothermal system hosted in carbonate rocks with water temperatures up to 50 °C. DHS includes both the thermal spring area in the Daruvar area and the western slopes of Mt. Papuk, which are predominantly built of the Mesozoic carbonate rock complexes and represent the recharge area of the thermal system. The objectives of the research are: i) the geometric reconstruction of discontinuities that drive the fluid flow, and ii) the estimation of the hydrogeological parameters of the carbonate thermal aquifer using structural, photogrammetric, and hydrogeological approaches. The regional structural setting was analysed through field investigations evidencing the occurrence of a polyphase deformation. In particular, NNE-SSW compression and ESE-WNW extension were identified, which are consistent with the deformation phases of the Pannonian Basin. Outcrop analogues of the carbonates constituting the thermal aquifer and affected by comparable multi-phase deformation of the rock mass were selected to detail the role of fracture systems on the permeability field. At selected locations, detailed photogrammetric measurements will be carried out and the vectorization of the fractures will be performed for the construction of a virtual outcrop (2D display of fracture traces). The results will be used to evaluate the geometrical parameters of the fractures (e.g., orientation, mean trace length, density, intensity) being the input parameters for discrete fracture network (DFN) modelling. The reconstructed network of discontinuities will be tested through hydrogeological numerical modelling using the DFN approach, thereby enabling the estimation of the hydraulic parameters of the rock mass. The estimated hydraulic parameters will be correlated with the results of pumping tests conducted in the Daruvar area.

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