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The role of hydrogeological conditions and thermophysical properties on the evaluation of geothermal exchange potential in Central Italy

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Within the framework of the EU strategy for sustainable development, the exploitation of the shallow subsurface geothermal resources is of great relevance. In this regard, a multidisciplinary investigation aimed at optimising the performance of borehole heat exchangers is in progress in the Marche region (Central Italy). In particular, an improvement of the present-day knowledge about thermo-physical parameters of the sedimentary deposits forming the Umbria-Marche succession, as well as the hydrogeological setting and geological structures, is fundamental in order to obtain a better picture of the regional geothermal exchange potential. Therefore, we carried out accurate laboratory measurements of thermal conductivity, volume heat capacity, thermal diffusivity, porosity, and density of both core and outcrop samples of the main geological formations of Marche, Moreover, the mineralogical content was defined through XRD diffraction. Because climatic variations can influence the moisture content of the shallower portions of the subsoil, the groundwater physical properties (temperature and electrical conductivity above all), have been continuously monitored for several years. Based on the collected data, a detailed thermo-fluid dynamic modelling was carried out under different, hydrogeological and geo-structural conditions to calculate the effect of groundwater velocity on the heat exchange between the boreholes and the ground. A relation, based on well-known non-dimensional parameters, was obtained in order to correct the purely conductive heat transfer on the basis of groundwater velocity. The preliminary results show that groundwater plays an important role, giving rise to higher heat exchange coefficients. This improves the present-day knowledge of the geothermal exchange potential in the region and overtakes previous analyses that only considered heat conduction.