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Workflow for the involvement of regional fluid pressure regime evaluation in geothermal resource characterization

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Deep confined carbonate aquifers are the most important geothermal resources outside of volcanic areas (Goldscheider et al 2010), such as Buda Thermal Karst, Hungary; Stuttgart in Germany (Ufrecht 2006); Chongqing, China (Yang et al. 2017). These are targets for power plant and direct-use implementations depending on temperature conditions. The necessary elements of natural geothermal systems are the reservoir, heat and fluids. However, the availability of fluids not only depends on the permeability of the reservoir but also the regional flow systems and fluid pressure conditions. Our knowledge regarding geothermal resources in the context of basin-scale flow systems, especially in deep confined carbonates are very restricted. Therefore, the main goal of the study was to suggest a workflow for the involvement of regional fluid pressure regime evaluation in geothermal resource characterization. It is key to understand of the availability, renewability of fluids and planning of their production and injection in geothermal systems. The proposed workflow was tested in the confined carbonate aquifer of the Paleogene Basin, Hungary.The methods of basin-scale hydraulic evaluation (Tóth 2009) such as potentiometric surface maps, hydraulic cross sections, pressure deviations were used in the frame of hydrostratigraphic groups and structural pattern.
Consequently, delineation of normal (characterized by upward, downward flow components), under- and overpressured areas in 3D resulted the derivation of hydraulic compartments for the area from the ground surface as deep as the carbonate aquifer. The biggest part of the carbonate region is characterized by normal pressure conditions. However, extensive underpressured regions can be found in the S and in the E. Some areas are characterized by slight overpressure. The location of pressure anomalies are under tectonic control (Mádl-Szőnyi et al. 2017)
Confined carbonates are significant thermal water resources, therefore the understanding of their flow pattern and pressure conditions are required. In case of natural geothermal sytems, the pressure regime can be significant in the resource characterization. Therefore, a workflow was proposed and demonstrated for the Paleogene Basin Hungary. The differently pressured regions were delineated based on hydraulic methods and resources were characterized (renewable and non-renewable). In addition, the geothermal consequences for production and injection were also evaluated. The proposed workflow can be used for geothermal resource evaluation for deep carbonate sytems. The research was supported by the Hungarian Research Fund (NK 101356).