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Regional groundwater flow conditions and preliminary geothermal potential in asymmetric basins

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Fluid, as an elemental component of a geothermal system, transports and distributes underground heat according to the topographic driving force within a groundwater basin. As the water table configuration has diverse and distinct forms in real-life basins, asymmetric hydraulic head variation may occur from basin to basin in accordance with real physiographic characteristics. Therefore, the effects of an asymmetric water table distribution in groundwater basins were investigated in several model sets with special emphasis on the temperature field and with the help of five response parameters: maximum temperature of outflowing water, average temperature, the portion of the thermal water reservoir, Péclet number and location and extent of thermal water discharge.

Our simulation results showed that in the absence of thermal springs, the extent of the thermal water reservoir might be larger and the temperatures might be higher. Sedimentary basin fill fosters the formation of heat accumulation under and within this unit. As a new “parameter” in the basin-scale groundwater and geothermal studies, basin asymmetry was introduced which has a critical role in discharge and accumulation patterns, thus it controls the location of basin parts bearing the highest geothermal potential. So if thermal water can reach the ground surface, the discharge might not take place exactly above the thermal water reservoir due to the asymmetric driving forces of groundwater flow. Furthermore, the extent and temperature of thermal water reservoirs are also influenced by local-scale anisotropy, heterogeneities, i.e. faults, fault zones and fractures, and, of course, basal heat flux.

Therefore, the application of asymmetric basin-scale models in preliminary geothermal potential assessment would be beneficial for understanding heat distribution. The results also have further implications on the identification of prospective areas and planning of shallow and deep geothermal energy utilization, the interplay between basin-parts and rejuvenation of geothermal resources.

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