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Deep seated carbonates and their vulnerability – are they isolated or hydrodynamically interacted?

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The vulnerability of carbonate systems is basically determined by their confinement (Mádl-Szőnyi and Füle 1998). Confined carbonate units are traditionally considered to be aquifer systems hydrodynamically independent of their siliciclastic cover and unconfined parts. This is due to the widely accepted view, that confining layers are generally impermeable relative to the underlying carbonate aquifers. The nature of how deep confined carbonate units are linked to unconfined gravity-driven regional groundwater flow (GDRGF) is poorly understood. The very first study of Mádl-Szőnyi and Tóth (2015) examined the flow systems for unconfined and for marginal areas of confined carbonate settings and adapted the Tóthian-flow pattern for unconfined and adjoining confined cases. The modified GDRGF pattern with considering further driving forces (such as buoyancy) was used as a working hypothesis for the numerical understanding of evolution of hydrodynamics of marginal areas of unconfined and confined carbonate aquifer systems by Havril et al. (2016).
In the recent study the main aim is the application of the GDRGF concepts to confined deep carbonates. Here the focal point is the handling of the karstified carbonate rock matrix and its siliciclastic cover as a whole. If we simplify the problem we can focus on to reveal the hydrodinamically interacted or insulated nature of confined carbonate systems. Beside hydrodynamic character of an area the salinity pattern can also reflect the potential connections. The interpretation of salinity in the context of GDRGF hydrodynamics therefore can assist in the determination of replenishment of formation waters with meteoric infiltration and can help to understand the flow pattern of the system. These hydrodynamic interactions also determine the vulnerability of carbonate systems not only in conventional sense but in relation to geothermal and hydrocarbon production.
The study area is located in the Hungarian Paleogene Basin of the Pannonian Basin (Báldi and Báldi-Beke 1985), in which the Pre-Cenozoic aquifers are mostly covered by Paleogene and Neogene formations. The study displays the flow pattern for the region; reveals the interrelationships between siliciclastic confining layers and carbonate aquifer system and shows the salinity character of fluids. The regional fluid pattern reveals the efficient interaction of unconfined and confined carbonates, the boundaries of the communication; in addition to demonstrate the protection role of confining layers which are important to understand the vulnerability. However, the interaction between confining layers and underlying aquifers were also recognized. It reflects the geological and tectonic pattern of the area. These research are significant for the understanding of vulnerability not only for surface human activity but also for geothermal and hydrocarbon intervention. The research was supported by the Hungarian OTKA Research Fund (NK 101356).