Dear Xiaolang Zhang,

First of all, thank you very much for your valuable comments. In this phase, we will answer the questions you raised, and the revised manuscript will be attached later, after we received all reviews.

General comment:
Some papers dealing with the combined effects of water table topography, thermal and haline buoyancy were mentioned in the Introduction (line 102–109: Hoyos et al., 2012; Gupta et al., 2015; Magri et al. 2015). The only one of these was the paper by Magri et al. (2015), whose results could be compared in a meaningful way, and we did so in the Discussion (line 530–536). Agreeing with your suggestion, other connecting papers (e.g. Zech et al., 2016; Kaiser et al., 2013a) will be discussed as well as potential areas will be presented, where considering the effect of topothermohaline convection, might be warranted in the future. This will be done in the revised manuscript.

In the Abstract, "water table topography" should be revised to "water table undulations."
We accept that 'water table undulation' is a slightly more accurate term to describe the phenomenon than 'water table topography'. However, topography-driven groundwater flow is the common expression (Mádl-Szőnyi et al., 2023), and topothermohaline convection includes this part. Thus, we would like to keep the original term, especially in the first sentence of the Abstract. In the first part of Introduction, a brief correspondence is made between water table topography and undulation.

Line 35: Should "horizontal variations in the water table" be "vertical variations"?
In classical Tóthian models (Tóth 1962;1963), where the upper boundary of the model was horizontal ($h_{wt}(x)$), clearly the horizontal variation of the water table ($\partial h_{wt}(x)/\partial x$) results in groundwater flow. However, in recent numerical models (like those presented in this manuscript), where the upper flow boundary of the model geometry follows the water table, it has (a minor) vertical variation as well resulting in a slight difference between the numerical solutions. Since this part of Introduction reflects the first mathematical handling of the problem solved by prof. József Tóth, we would like to keep the original version.

Line 38: Revise "thereof."
To clarify, a minor modification was made in the sentence: ‘can be considered as its subdued replica’.

Line 144: How do you account for the relationship between salinity and density?
Water density depends on the temperature (6th order polynomial), the pressure (2nd order polynomial) and the salt concentration (1st order polynomial) (line 160–162). A linear relation between the water density and the concentration of

$$\rho_w(c) = \rho_{ref}(1 + \beta c)$$

was applied after the recommendation of Kohfahl et al. (2015), where $\beta=7.1\cdot10^{-4}$ l/g. This term was built in the whole formula of $\rho_w(T,p,c)$ which will be quantified in a new Supplementary material.

Line 173: How do you ensure that the model discretization (time step and spatial mesh size) meets the requirements for the Peclet number and Courant number?

For the simulations, we used COMSOL Multiphysics 5.3a, which is a finite element software package to solve coupled partial differential equation systems (Zimmerman, 2006). For discretization of time stepping in COMSOL, the Backward Differentiation Formula (BDF) was chosen, which is suggested for diffusion and convection problems due to its stability and robustness. To control BDF,

- the maximum time step was fixed at 100 yr for synthetic model calculation and 20 yr for simulating topothermohaline convection along a 2D section in the Buda Thermal Karst system having more complex geometry.
- A backward Euler scheme with an order of 1 or 2 was chosen to generate linear equation system, which was solved by a direct solver (MUMPS). If the global error (including both time stepping error and algebraic solution error) obtained from BDF exceeded a threshold (controlled by both relative and absolute tolerance), the time step was refused and
   i. the size of the time step was decreased (typical), or/and
   ii. the order of time discretization was increased

  to reduce the global error (summing up local errors) and to ensure the accuracy and the robustness of the numerical solution.
- In addition, both the non-dimensional Courant and Péclet numbers were calculated for each finite element and time step to check manually the local distribution of spatial and temporal quality of numerical solution.
- For example, the cell Péclet number, *Pe* was calculated for the mass transport (Darcy flux*cell size/molecular diffusion), which exceeded the value calculated for heat transport by orders of magnitude. In this way, *Pe* was much larger than 2 as a classical limit to characterize the accuracy of spatial discretization. However, this strict criterion is rarely used in practice, as it would require a very small element size. Instead, we applied consistent stabilization (crosswind and streamline diffusion), as a trade-off between sufficient accuracy and adequate element size (e.g. Diersch and Kolditz, 2002).
- Finally, a 1D stationary analytical model was built up to check the spatial accuracy of age transport simulation (Szijártó et al. 2025). Comparison between analytical and numerical solution of water age proved that the average and maximum relative deviations are below 10^{-3}% and 10^{-1}%, respectively, even for $Pe \gg 2$.

Line 184: The boundary condition for a constant salinity concentration seems unreasonable. While the heat source can originate from deep geologic units, where does the constant salt flux come from?

In advance, all boundary conditions are artificial and only an approximation of reality. In Hungary, it is typical that the salt concentration of water increases with depth. It is a consequence of (1) the sedimentation that took place predominantly in a marine, saline water environment (line 404) and (2) the precipitation providing recharge that mainly reduces the salinity of the shallower layers. Consequently, a basement beneath the aquifer modelled has a higher salinity due to its lower permeability. It is worth noting that the model itself clearly shows that the low-permeability clayey Oligocene layer is able to retain its original salinity (HS6 in Fig. 11), despite (1) being at relatively shallow depths and (2) the presence of high-permeability aquifers below and above it. In addition, there are a number of hydrogeological situations where the aquifer is located above evaporites, halite formations (e.g. Kaiser et al, 2011; 2013b; Gupta et al. 2015; Magri et al., 2015; Zech et al., 2016), and thus salt source from a lower aquitard is almost constantly ensured. Nevertheless, the constant salt concentration prescribed along the bottom boundary was varied in a very wide range from 2 to 200 g/l,

including many hydrogeological situations. Furthermore, a new model will be presented in the Supplementary material, in which the evolution of the BTK system will be investigated using (1) different lower boundary condition for the salt concentration and (2) temperature-, pressure- and concentration-dependent water viscosity.
Finally, we emphasize that the salinity concentration along the bottom boundary was constant during the simulations and not the salt flux.

Figure 10: The caption font is too small to read.
Thank you, the indexes are clearly readable in the original file format, but pdf generation deteriorated its quality. We will take care of it and now we attach the original figure.

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