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Evolution of intrastratal karst within evaporitic sequences

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The presented study simulates the evolution of an intrastratal halite karst, which is embedded in a sequence of carbonates, marls, anhydrites and gypsum. A numerical model is developed to simulate laminar flow in a sub-horizontal void similar to a developing intrastratal karst. The numerical model is based on the laminar steady state Stokes flow equation, and the advection dispersion transport equation coupled with the dissolution equation. The flow equation is solved using the nonconforming Crouzeix-Raviart (CR) finite element approximation for the Stokes equation. For the transport equation, a combination between Discontinuous Galerkin Method and Multi-point Flux Approximation Method is proposed. The numerical effect of the dissolution is considered by using a dynamic mesh variation that increases the size of the mesh based on the amount of dissolved salt. The numerical method is applied to a 2D geological cross section representing Horst and Graben structures bound by normal faults in the Tabular Jura of north-western Switzerland. The model simulates salt dissolution within the geological section and, therefore, also predicts the amount of vertical displacement of the halite−intrastratal karst interface. The interface displacement serves as an indicator of potential subsidence that could occur at the surface above. Simulation results showed that the highest dissolution amount is observed near the hydraulically higher conductive normal fault zones. Therefore, the highest surface subsidence rates are expected above normal fault zones. The temporal and spatial distribution of the simulated dissolution along the 2D cross sections can be qualitatively compared to the shape and subsidence rate of the observed subsidence areas in the same area of the Tabular Jura.