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Density-dependent groundwater flow and dissolution potential along a salt diapir in the Transylvanian Basin, Romania

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Salt diapirs and the surrounding sediments are often involved in a variety of human activities, such as salt mining, exploration and storage of hydrocarbons, and also storage of radioactive waste material. The presence of highly soluble evaporitic rocks, a complex tectonic setting related to salt diapirsm, and human activities can lead to significant environmental problems, e.g. land subsidence, sinkhole development, salt cavern collapse, and contamination of water resources with brines. In the Transylvanian town of Ocna Mures. rock salt of a near-surface diapir has been explored since the Roman ages in open excavations, and up to the 20th century in galleries and with solution mining. Most recently, in 2010 a sudden collapse in the adjacent Quaternary unconsolidated sediments led to the formation of a 70-90m wide salt lake with a max. depth of 23m.

Over the last 3 years a Romanian-Swiss research project has led to the development of 3D geological and hydrogeological information systems in order to improve knowledge on possible hazards related to uncontrolled salt dissolution. One aspect which has been investigated is the possibility of density-driven flow along permeable subvertical zones next to the salt dome, and the potential for subsaturated groundwater to dissolve the upper sides of the diapir. Structural 3D models of the salt diapir, the adjacent basin sediments, and the mining galleries, led to the development of 2D numerical vertical density-dependent models of flow and transport along the diapir. Results show that (1) increased rock permeability due to diapirsm, regional tectonic thrusting and previous dissolution, and (2) more permeable sandstone layers within the adjacent basin sediments may lead to freshwater intrusion towards the top of the diapir, and, therefore, to increased potential for salt dissolution.