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Process understanding, scalability and transferability of fluid-rock interactions in salt deposits

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Salt deposits do not only have a large economic significance as a resource, but are of increasing interest as energy storage space. Due to the poor permeability of salt rock, the storage of various energy-rich fluids in technical caverns is increasingly practiced to secure a stable energy supply in the course of fluctuating availabilities from renewables.
To ensure long-term integrity and safety of technical caverns during their operation and abandonment, new concepts for examination and monitoring approaches are needed. This requires a detailed process understanding of the multiphase system salt–gas–water in the transition zone between cavity and solid rock.
Within the framework of the project ProSalz, questions on the temporal and spatial dimensions of fluid migration in the margins of cavernous salt structures are addressed using a range of geochemical, isotope and geophysical techniques coupled to numerical simulations and modeling. The overall aim of the study is a better understanding of the interaction between salt mineralogy, moisture content, gas composition as well as temperature and pressure gradients and eventually the influence of these parameters on the fluid migration behavior.
The work comprises investigations at various dimensions to validate the transferability of results.
As storage caverns are not directly accessible, comparable structures in an underground salt mine serve as an ideal analogue for in situ observations of multiphase processes where naturally migrating fluids produce cavernous structures. The marginal transition zone will be examined along different profiles. Furthermore, an artificial cavity will be created in a salt pillar in order to simulate and observe cavern-like processes under in situ conditions.
Complementary simulations and investigations take place at the laboratory scale, comprising experiments in a large reservoir simulator with a volume of 400 L, down to the microscopic range of fluid inclusions.
The resulting data encroach on process-based modeling approaches, applicable to natural and artificial cavernous systems in salt deposits.