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Understanding dilatancy in rocksalt: a microphysical model of rocksalt at the grain-scale

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The use of underground repositories excavated in low-permeability formations, such as rock salt, to store high-level, radioactive waste requires the analysis of its isolation properties. Underground excavation disturbs the original stress state of the rocksalt, resulting in a deviatoric stress distribution around the walls of excavated galleries and boreholes. At high deviatoric stresses and low confinement, dense rocksalt produces an increase in porosity and permeability. The extent of dilatancy in this disturbed zone, as well as the impact of dilatancy on the transport properties, are important for assessing the safety of radio-active waste disposal as well as the integrity of salt caverns and boreholes in the context of energy storage, brine cavern abandonment and gas well abandonment.

The stress conditions at which dilatancy occurs have been measured experimentally, and are typically determined on the basis of macroscopic (sample-scale) measurements of volumetric strain and permeability, and/or acoustic velocity changes or emissions. However, the detailed mechanisms causing dilatancy at the grain-scale are poorly understood. We have developed a microphysical model for dilatancy in rocksalt, both under dry and wet conditions, including mechanisms such as slip and opening of grain boundaries. This model enables us to describe and predict the dilatancy behaviour of rocksalt based on physical, mechanical and chemical processes. The model is presently being independently verified through comparison with existing literature data, and new experiments.