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Rheological contrasts in salt and their effects on flow in salt

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The majority of numerical and analogue models of salt tectonics assume homogeneous rheological models, and consequently produce simple internal structures. This is in contrast to observations in salt mines and 3D seismic, showing complex folding at a wide range of scales, in combination with boudinage and fracturing, which point to large rheological contrasts in salt bodies.
The rheology of rock salt during slow deformation can be both Newtonian and Power law. Dislocation creep and dissolution-precipitation processes, such as solution-precipitation creep and dynamic recrystallisation, both play a significant role and grain boundary healing in deforming salt may result in cyclic softening and hardening behaviour. The switch between these processes can cause major changes in rock salt rheology, at time scales both relevant to geologic evolution and subsurface operations.
In the dislocation creep field, a compilation of laboratory data show that different rock salts can creep at four orders of magnitude different strain rates under otherwise the same conditions. Potassium - Magnesium salts are in turn much weaker, and Anhydrite much stronger than rock salt. Anhydrite - carbonate inclusions embedded in deforming salt bodies respond to the movements of the salt in a variety of ways including boudinage and folding.
New methods of microstructure analysis integrated with paleorheology indicators observed in natural laboratories allows an integration of these data and the development of a unified model for salt creep for both underground cavities and natural deformation, including the effect of high fluid pressures in salt which lead to a dramatic increases in permeability. For example, modeling of anhydrite stringer sinking is an important way to obtain the long term rheology of the halite, indicating that the rheology of Zechstein salt during the Tertiary was dominated by dislocation creep.
These form the basis of a new generation of mechanical models to predict the complex coupling between the internal deformation of the salt and the evolution of the surrounding sediments.