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How rheological heterogeneities control the internal deformation of salt giants.

Alexander Raith and Janos L. Urai
RWTH Aachen University, Geologie-Endogene Dynamik, Aachen, Germany (a.raith@ged.rwth-aachen.de)

Salt giants, like the North European Zechstein, consist of several evaporation cycles of different evaporites with highly diverse rheologies. Common Potassium and Magnesium (K-Mg) salt are typically 10 to 100 times less viscous as halite while stringers consisting of anhydrite and carbonates are about 100 times more viscous. In most parts, these mechanically layered bodies experienced complex deformation, resulting in large scale internal folding with ruptured stringers and shear zones, as observed in seismic images. Furthermore, locally varying evaporation history produced different mechanical stratigraphies across the salt basin. Although most of these extraordinary soft or strong layers are rather thin (<100 m) compared to the dominating halite, we propose they have first order control on the deformation and the resulting structures inside salt bodies.
Numerical models representing different mechanical stratigraphies of hard and soft layers inside a salt body were performed to analyze their influence on the internal deformation during lateral salt flow. The results show that a continuous or fractured stringer is folded and thrusted during salt contraction while soft K-Mg salt layers act as internal décollement. Depending on the viscosity of the fractured stringers, the shortening is mostly compensated by either folding or thrusting. This folding has large control over the internal structure of the salt body imposing a dominating wavelength to the whole structure during early deformation. Beside strong stringers, K-Mg salt layers also influence the deformation and salt flow inside the salt pillow. Strain is accumulated in the soft layers leading to stronger salt flow near these layers and extensive deformation inside of them. Thus, if a soft layer is present near a stringer, it will experience more deformation. Additionally, the strong strain concentration in the soft layers could decouple parts of the salt body from the main deformation.