EGU24-19007, updated on 20 Mar 2025
https://doi.org/10.5194/egusphere-egu24-19007
EGU General Assembly 2024

The microstructure of naturally deformed gneissic Zechstein 2 rock salt (Kristallbrockensalz) from the northern Netherlands – a review

Jessica Barabasch[1,2], Joyce Schmatz[3], Jop Klaver[4], Alexander Schwedt[5], and Janos L. Urai[2]
[1]Brenk Systemplanung GmbH, Heider-Hof-Weg 23, 52080 Aachen, Germany (j.barabasch@brenk.com)
[2]Institute for Structural Geology, Tectonics and Geomechanics, RWTH Aachen University, Lochnerstrasse 4-20, 52056 Aachen, Germany
[3]MaP – Microstructure and Pores GmbH, Junkerstrasse 93, 52064 Aachen, Germany
[4]Pondera Consult, Amsterdamseweg 13, 6814 CM Arnhem, Netherlands
[5]Central Facility for Electron Microscopy (GFE), RWTH Aachen University, Ahornstr. 55, 52074 Aachen, Germany

Janos Urai's contributions have significantly enhanced our understanding of salt deformation, particularly in predicting the long-term evolution of solution-mined caverns and radioactive-waste repositories in salt formations. His work delved into phenomena such as the weakening of rock salt by water during long-term creep at low differential stresses. Unlike most laboratory measurements, which are at higher differential stress, Urai's research considers dislocation creep and pressure solution (dissolution-precipitation creep), processes not commonly included in current engineering predictions.

Microstructural observations on Zechstein 2 (Z2) rock salt cores in the northern Netherlands reveal substantial grain-size-dependent differences in rock salt rheology. The study compares undeformed salt layers with strongly deformed diapiric ones, showcasing variations in megacrystals and fine-grained halite microstructures that point to different microphysical processes. The microstructural analysis, including optical microscopy of gamma-irradiated thin sections, recrystallized grain-size measurements, electron microscopy, and subgrain-size piezometry, indicates differential stresses between 0.5 and 2 MPa during deformation.

The findings highlight the importance of pressure solution creep at low differential stresses, demonstrating its significant impact on strain rate in rock salt. Integrating these results into constitutive flow laws reveals a four-order-of-magnitude difference in strain rates between halite types, emphasizing the role of different dominant deformation mechanisms. The study suggests that incorporating pressure solution creep and microstructural analysis can substantially enhance engineering and tectonic models of rock salt deformation in low-stress conditions.