Fluids and fluid migration in salt

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Fluids in evaporates (solvents and non-solvents)

Fluids can move through evaporites over geologic time, in fractures and in dilatant grain boundary networks. Opening and sealing of transport paths is an important process in this migration. This process can be local or long distance and involve different amounts of fluid. The main controlling parameter in this process is the ratio of fluid pressure and minimum stress.

By understanding fluid migration processes in natural evaporites, we can build quantitative models which describe processes at time scales not accessible in the laboratory, describe the present-day structure of fluids in repository and better predict their response to the changing boundary conditions in repositories.

Figure 1: The rock salt cycle

1. The full paper being unavailable at the time of publication, a slightly adapted version of the contribution as presented at the symposium is provided here.
Figure 2: Different stages in the rock salt cycle

Figure 3: The healing of grain boundaries with water

Compaction, crystallisation, GB healing

Dilatancy, fluid infiltration, recrystallisation

Drury and Ural 1984
Figure 4: Miniature triaxial cell

Figure 5: A “brine pocket”
Figure 6: Mobile hydrofactures in gelatin (Paul Bons)

Figure 7: Omani salt
Figure 8: Omani salt basis

Figure 9: In situ stress and fluid pressure in Ara salt
Figure 10: SOSB stringer pressure regimes

Kukla, et al., forthcoming.

Figure 11: Microstructure of Ara salt

Source: Johannes Schoenherr.
Figure 12: Black salt and bitumen


Figure 13: Core plugs of bitumen-impregnated halite

Dilatancy is only possible at near-zero effective stress – i.e. fluid pressure must be lithostatic.


Figure 15: Conditions for oil flow through salt

Figure 16: Stress in salt basins

\[ \sigma_v = \Sigma \rho g \Delta z \]

These two stresses should be equal!

Better understanding of stress in a salt basin
Equilibrium and short term geological effects

Figure 17: Porosity waves
Figure 18: Anhydrite veins from Zechstein-fluids

Figure 19: Infiltration process after 165, 440 and 530 years

Figure 20: Solution-precipitation creep and fluid flow in halite

Figure 21: The folded halite layers contain halite-filled veins
Figure 22: Experimental sealing of fractures in salts

Figure 23: Blocky halite crystals in the vein
Figure 24: Z3 surface in Groningen area

Figure 25: Rupture process modelled using DEM
Figure 26: Stringer fractures modelled using DEM

More brittle

Stronger

Abe and Urai (subm)