Geophysical Research Abstracts
Vol. 21, EGU2019-14584, 2019
EGU General Assembly 2019

Ion-species in pore fluids with opposite effects on limestone fracturing

Anne Pluymakers (1), Audrey Ougier-Simonin (2), and Auke Barnhoorn (1)

(1) Geosciences & Engineering, TU Delft, Delft, the Netherlands (anne.pluymakers@tudelft.nl), (2) Rock Mechanics and Physics Laboratory, British Geological Survey, Nottingham, UK (audreyo@bgs.ac.uk)

Due to their solubility, limestones are prone to fluid-assisted deformation, with occasional dramatic effects of fluid chemistry. For example, seawater injection in the 80's to halt subsidence in the offshore Ekofisk oil field led to an additional 10 m of subsidence instead, clearly demonstrating the limit of our understanding on how fluid composition affects rock-mechanical behaviour. So, limestone being one of the most common hydrocarbon and geothermal energy reservoirs, a proper understanding of saturated limestone deformation behaviour is paramount. Here, we performed triaxial tests on limestone samples exposed to 2 similar saline solutions, MgSO4 and Na2SO4, both known to be commonly present in carbonate reservoirs. We show that these salts have significant different effects on the rock deformation behaviour with an interwoven dependence on the salt in presence, the exposure duration of the rock to the salt and the regime of deformation. Exposure times of 1 day already change the failure dynamics and microstructure, and 200 day exposures led to 50 MPa strength differences compared to dry or wet reference cases. This indicates that short-term disturbances to the chemical equilibrium can be accompanied with large mechanical changes. Since geo-engineering deals with short timescale fluid extraction and injection, we stress that such drastic changes of the mechanical response of the same rock subjected to a small difference in fluid composition need to be known beforehand.