CO_2 long-term periodic injection experiment at Mont Terri (CO_2LPIE)

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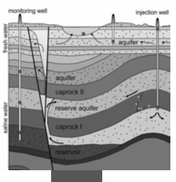
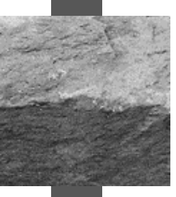
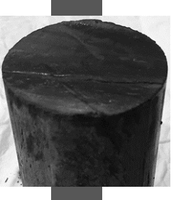
motivation + goals



- **use of the subsurface**, e.g., CO_2 sequestration, geothermal energy, nuclear waste, energy storage
- **understanding of reservoir complex** required for reliable site specific characterisation, prediction, and risk assessment
- **investigations on barrier rocks** need to be intensified in respect to properties and alterations, here Opalinus clay can act as representative proxy



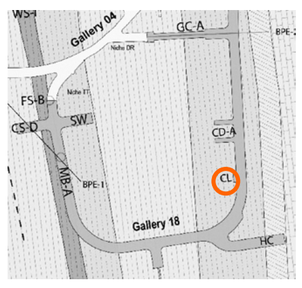
- **knowledge of geomechanical and geochemical parameters** is essential, e.g. reactivity rates, mobility values, in-situ permeability



- **data based on long-term experiments** contribute higher precision, improvement of estimated or extrapolated data, esp. extension of *pT*-coverage and long-term evolution
- **injection of CO_2** gives information on geochemical reactions with minerals and fluids in contrast to inert tracers, adsorption of CO_2 in clay, behaviour of CO_2, pressure development, deformation

concept + measurements planned

- **boreholes in existing Niche Cl** for injection and monitoring, > 10 m, perpendicular to bedding in undisturbed rock (< 25 % sand content, no carbonates), site characterisation based on mini-seismic, geoelectric, drill core, literature

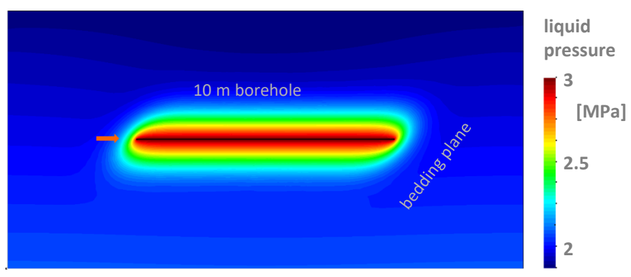


Raselli et al., 2019, swisstopo

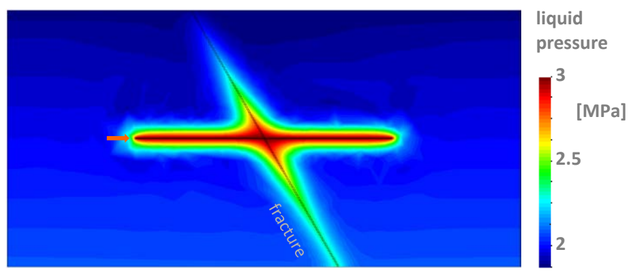
- **baseline measurements** of temperature, pressure, chemistry, deformation
- **periodic CO_2 injection (+ tracers)** scenario dependent on feasibility, >10 a
- **continuous monitoring** with redundant sensors and measurement principles
- **synergy of in situ experiment, laboratory measurements, numerical modelling** of geochemical and geophysical parameters

preliminary numerical 2D THM models

- **simulations of coupled thermal, hydraulic, mechanical, and chemical processes** (THMC) for feasibility study, design of experiment, blind predictions of CO_2 evolution; enhanced calibration
- **CO_2 injection** at 3 MPa i.e. 1 MPa above hydrostatic pressure, for 10 a, THM-model using CODE-BRIGHT, fluid pressure anisotropy due to bedding plane angle



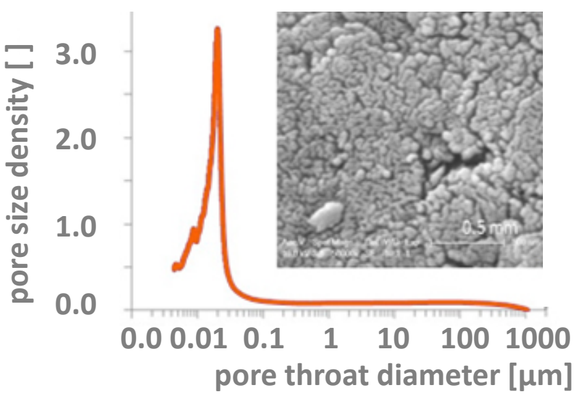
- **CO_2 injection with fracture present**, for 1 a, other conditions same as above, fluid pressure anisotropy due to existing fracture

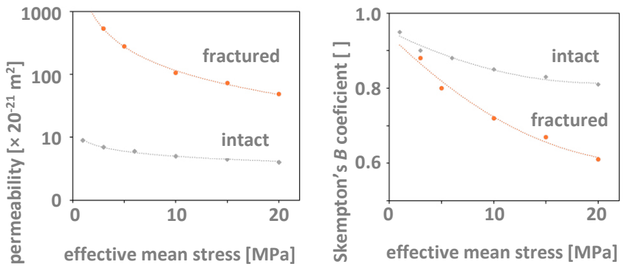


- **preferential flow paths** may follow existing or new flow , which might increase permeability in two orders of magnitude
- **CO_2 dissolves into pore water** of Opalinus clay, but does not appear in free phase

experimental laboratory investigations

- **multiphysical characterisations** of Opalinus clay via the analysis of THMC effects using core flooding and triaxial testing
- **intact and fractured** Opalinus clay specimens show difference in permeability of up to two orders of magnitude





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