FIELD-SCALE FAULT REACTIVATION EXPERIMENTS BRIDGE LABORATORY-SCALE INVESTIGATIONS

Field experiments provide testing and observation in real-world scenarios.

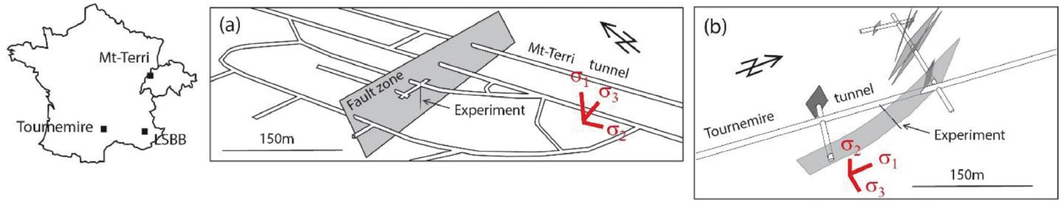
PREDICTING THE BEHAVIOR OF PRESSURIZED CAPROCKS IS CRITICAL FOR SUCCESSFUL LONG-TERM STORAGE OF CO_2

Small-scale field experiments provide important new insights.

Fault reactivation experiments were performed in the Opalinus Clay in the Mont Terri Underground Research Laboratory (URL) in Switzerland and in the Tournemire Clay in France to test fault behavior under pressurized conditions.These tens-of-meter-scale experiments, few of which have been conducted to date, enable high-resolution, real-time observation of complex faults and tracking of fault slip and induced seismicity.

Results imply that shale faults ruptured by local fluid pressure increases could cause significant leakage.

However, because such shale faults may not trigger significant seismic activity, **seismicity may not be a reliable predictor of loss of caprock integrity in these rocks**.



(a) Mont Terri URL Main Fault experiment at 350m depth; (b) Tournemire URL experiment at 250m depth

Experiment: Sealed sections of boreholes were pressurized with fluid to trigger millimeter-scale slip. The monitoring boreholes were equipped with a step-rate injection monitoring of fracture in-situ properties (SIMFIP) tool and multiple types of seismic sensors, which enabled continuous monitoring of three-dimensional displacements of the fault simultaneously with injection pressure and flowrate.

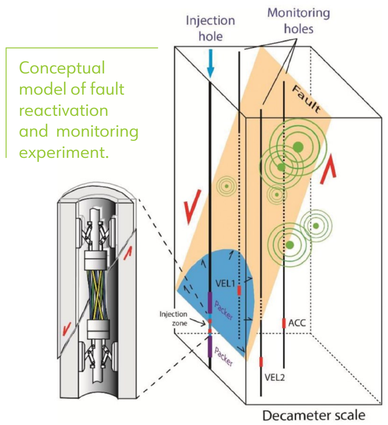
Drilling and coring at Mont Terri with 52mm ID casing.

NEW MONITORING METHODS TO ASSESS AND MITIGATE RISKS

These experiments will be further refined to assess the wide variety of rock types under consideration for storage by:

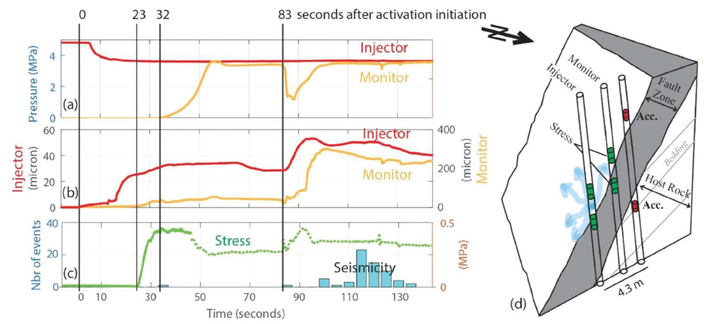
- Monitoring effects from minutes to days.
- Examining different injection protocols from pressure-controlled to flow-rate-controlled types.
- Monitoring fault displacement, pore pressure, and micro-seismicity in the nearfield of the injection source.

Conceptual model of fault reactivation and monitoring experiment.



RESULTS VALIDATE GEOMECHANICAL SIMULATIONS FOR FAULT REACTIVATIONS

- Significant leakage was observed when shale faults were reactivated by local fluid pressure increases.
- Rupture was associated with significant aseismic slip.
- Only small-magnitude seismicity (Mw < -2.5) was observed outside the pressurized leakage patch.
- After activation, the shale faults clamped to almost zero permeability, although not to a complete seal.



PARTNERS

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