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Nonlinear Elasticity and Carbon Storage Site Containment Assurance

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Nonlinear time reversed focusing will be applied to map formation damage for the currently active progressive failure (PF) experiment in the Mont Terri underground rock laboratory (URL). This In-situ experiment monitors structurally-controlled rock mass deformation and damage. Complex shear failure occurs in the heavily instrumented 600 mm diameter micro tunnel, finding borehole breakout and complex fracture swarms controlled by bedding rather than stress anisotropy. Fractures and shear bands appear to self-heal away from the tunnel wall, possibly restoring original sealing capability to this caprock seal proxy for CO2 storage. Does this caprock fracture self-healing behavior help explain the lack of CO2 breach in Enhanced Oil Recovery (EOR) projects now in operation for over 50 years? Can nonlinear acoustics measures provide a means of quantifying these fracture healing attributes?

The NL measurements will be coupled to active measurements at the PF site that include photogrammetry, fiber optical strain sensing, seismic and electrical resistivity topographies.

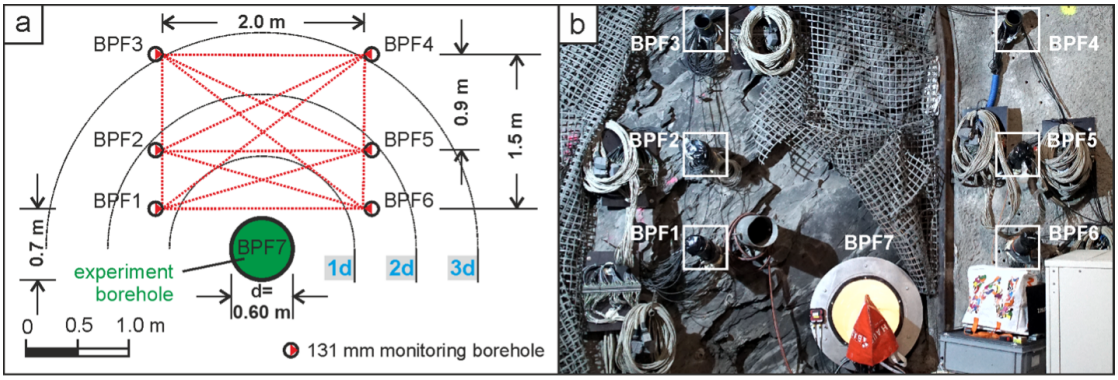

Figure 1: (a) Layout in plane view of the PF project's borehole array. Six monitoring boreholes (BPF1–6) locate above a central, large, and unsupported experiment borehole (BPF7). (b) Overview photograph of the installed experiment location at the MI niche of the Mont Terri URL. Modified after M. Ziegler, Swiss Federal Office of Topography (swisstopo)

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