In Situ Acoustic Measurements

Wave Focusing and Fracture Characterization Feasibility Study

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$f = 50 \text{ kHz}$

$d \sim c/(4f)$

$w \sim \pi f$
In Situ Experiments

• Purpose

• Setup

• First results
Purpose

• Test our ability to scale lab measurement to field for both instrumentation deployment and frequency range change
  ✓ Tests were done at the Mont Terri Underground Laboratory, Switzerland in shale
  ✓ Equipment shipped from LANL
  ✓ Low Frequency sources used for larger scale experiment

• Primary goal: focus acoustic waves in the formation

• Secondary goal: measure nonlinear signature from formation fractures
Setup

3D Laser Vibrometer in TT-Niche

Acoustic Sources in Borehole

Scan Area
Results: Focus Elastic Wave Energy
Results: Nonlinear Wave Signature

Graphs showing the nonlinear wave signature away from and near a crack. The graphs compare the wave behavior at different distances from the crack, highlighting the differences in wave patterns between these two regions.
Conclusion

• TR focusing is possible in the formation.
• Nonlinear elastic wave signatures are present at/near fractures in the formation.
• Learned valuable information on the deployment of these techniques at this scale.

Plan Forward

• Additional lab-scale measurements to characterize fractures in granite.
• Return to MT for expanding measurements to EDZ.