In Situ Acoustic Measurements

Wave Focusing and Fracture Characterization Feasibility Study

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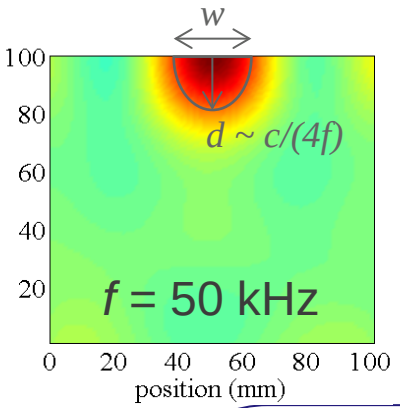
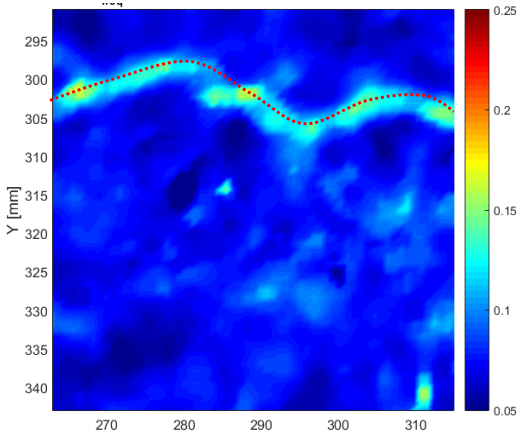
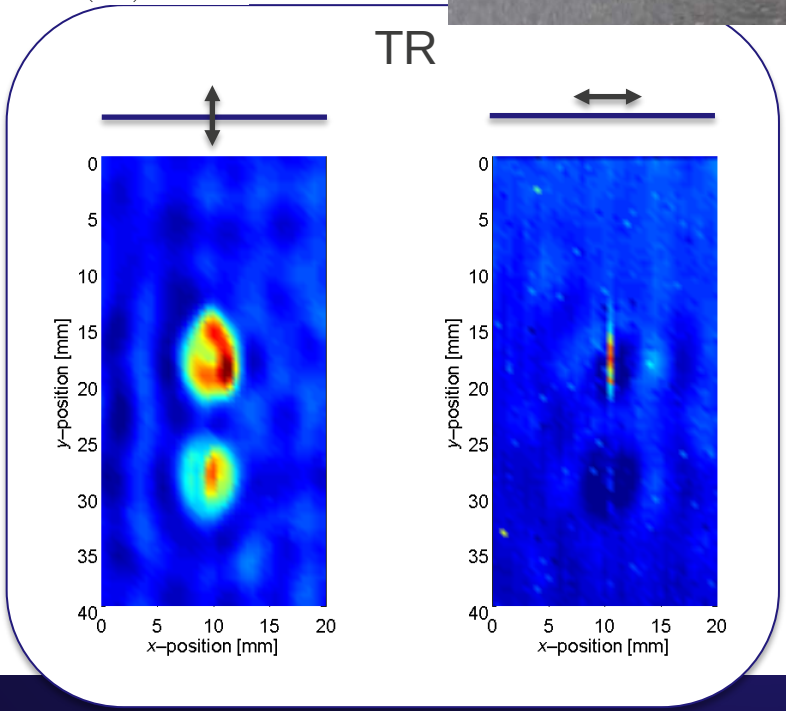
NNSA
National Nuclear Security Administration
Operated by Los Alamos National Security, LLC for the U.S. Department of Energy's NNSA



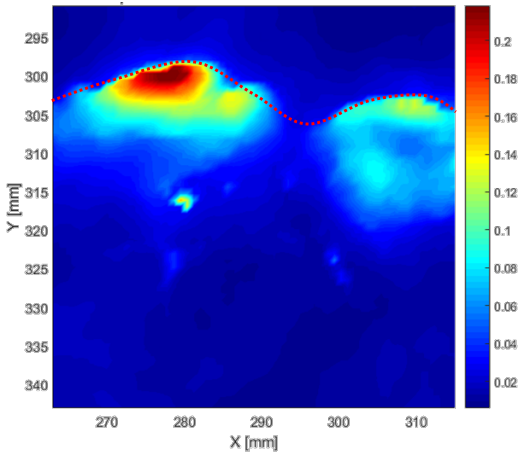
200 kHz

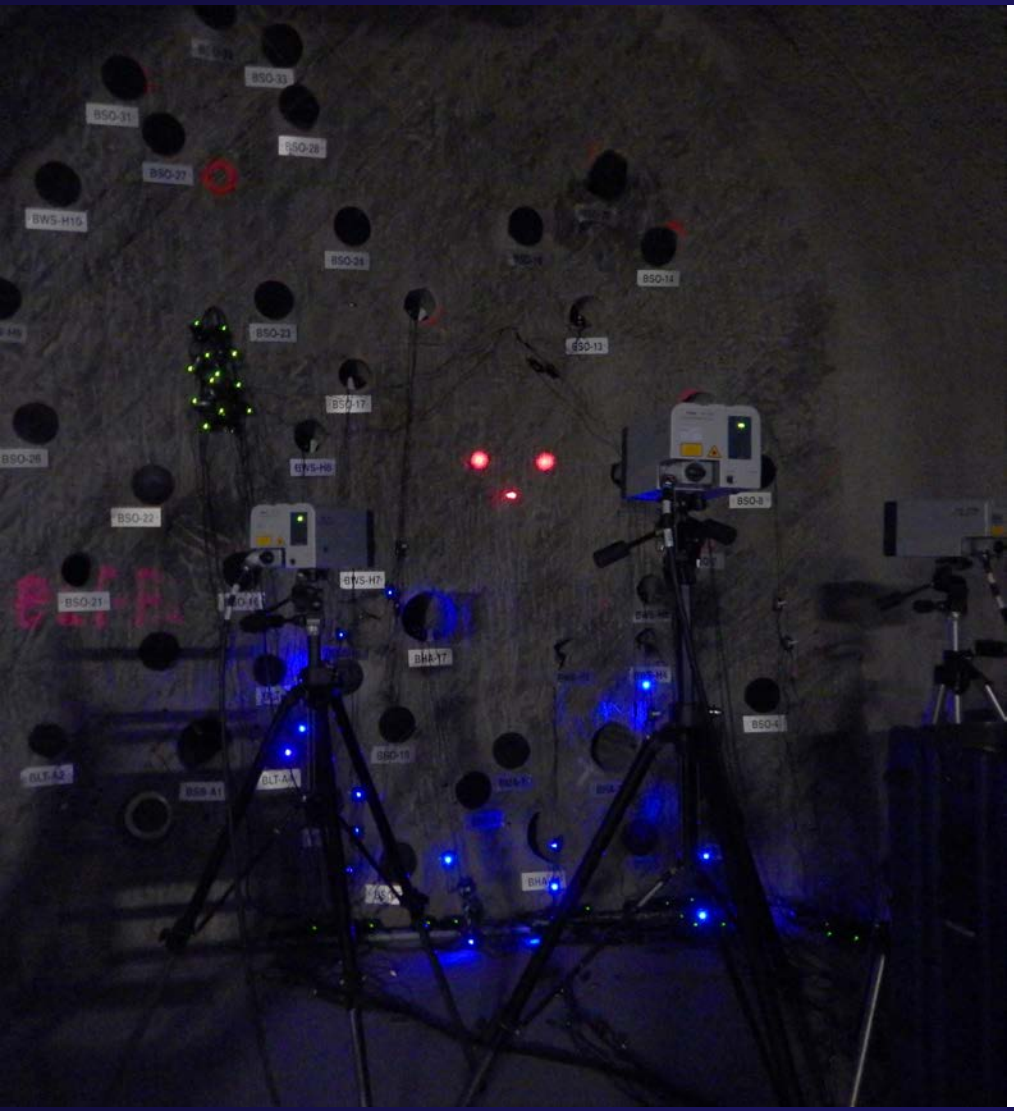


TR



100 kHz





In Situ Experiments

- **Purpose**
- **Setup**
- **First results**

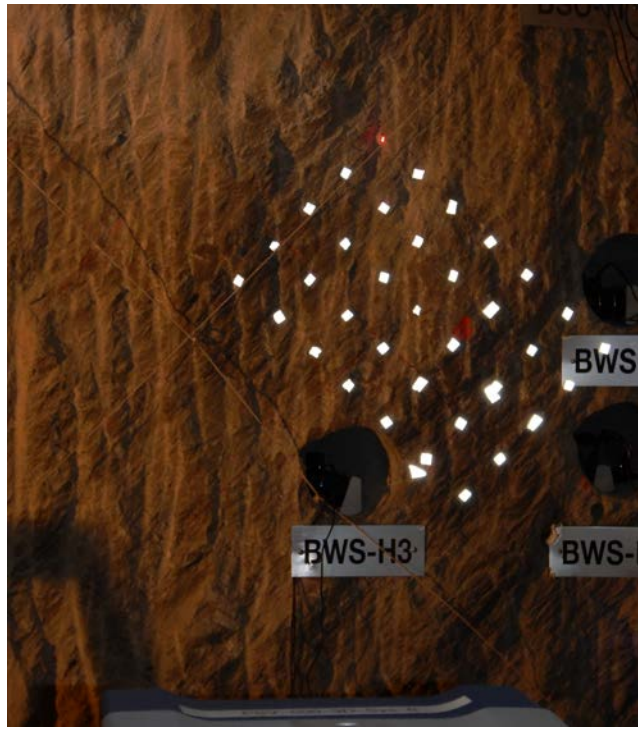
Purpose

- **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

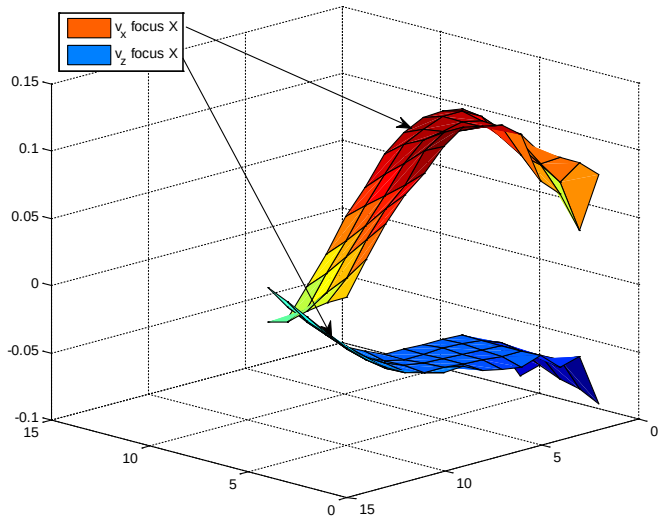
3D Laser Vibrometer in TT-Niche

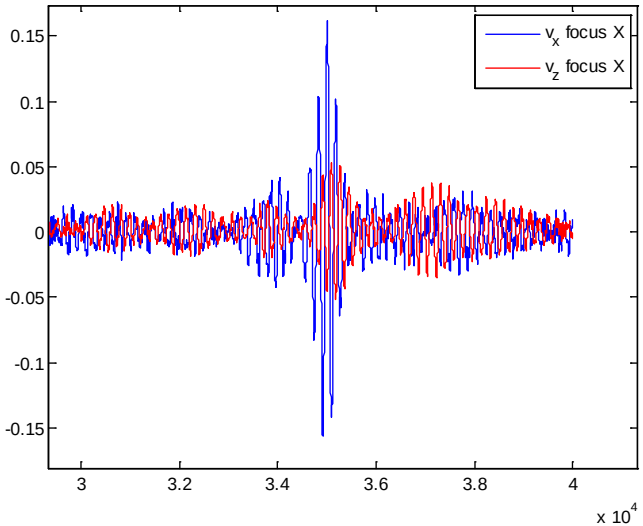
Acoustic Sources in Borehole



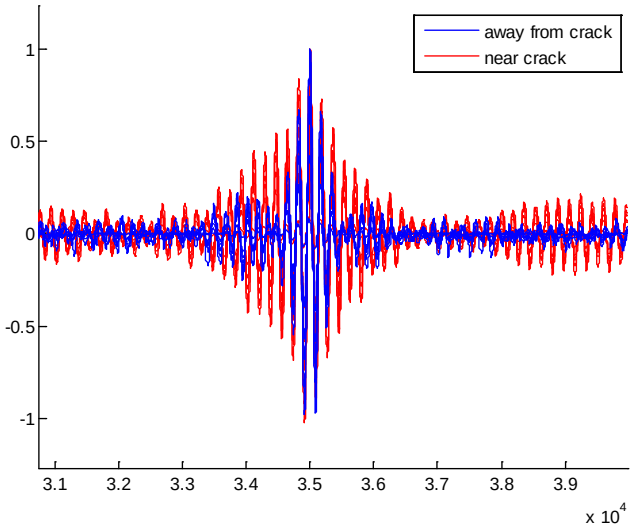
Scan Area

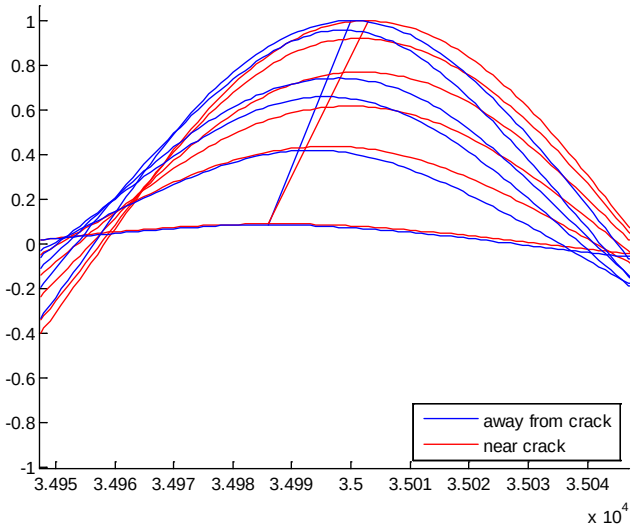
Results: Focus Elastic Wave Energy

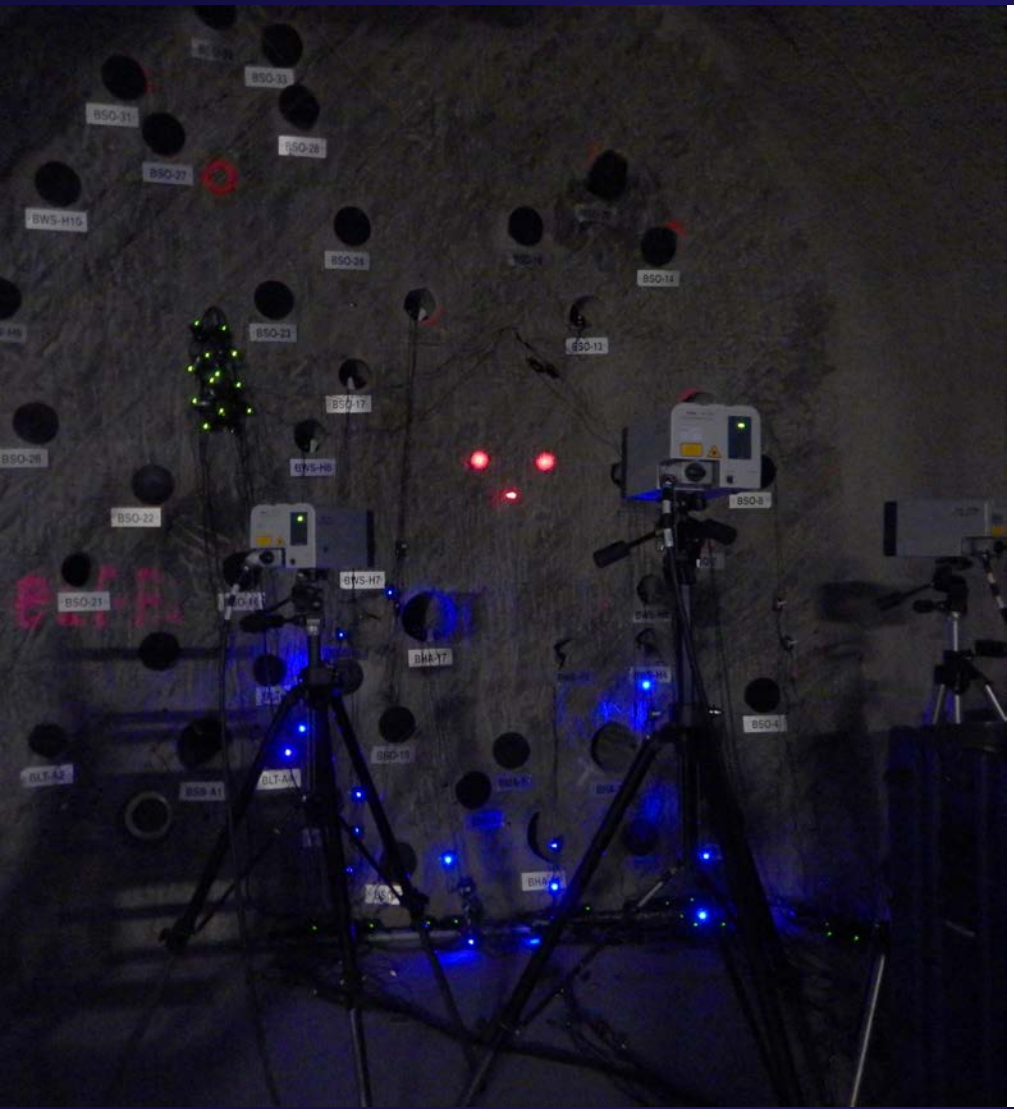




Results: Nonlinear Wave Signature







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.**