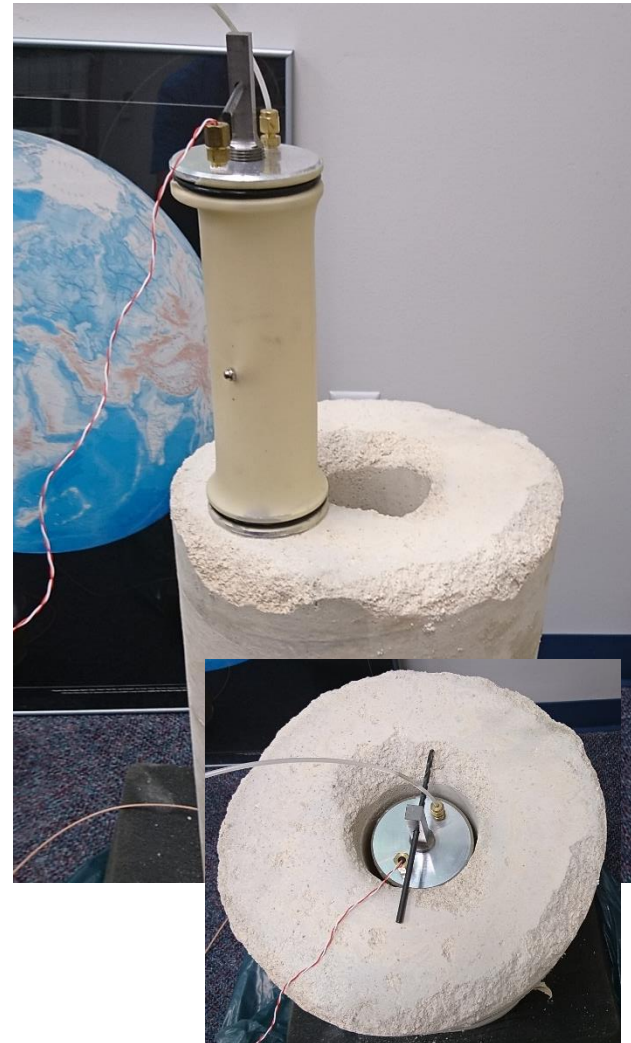


Implementation of Down-Hole Geophysical Testing for Rock Sockets

Dennis R. Hiltunen
University of Florida

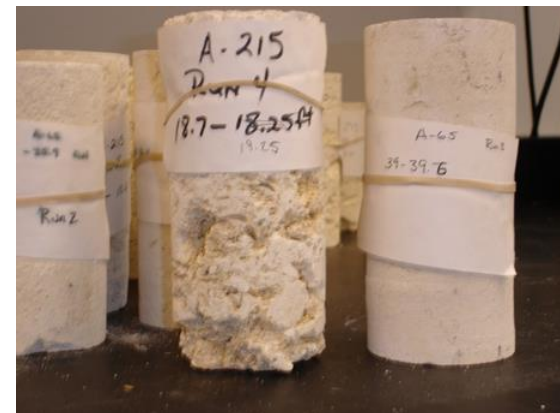
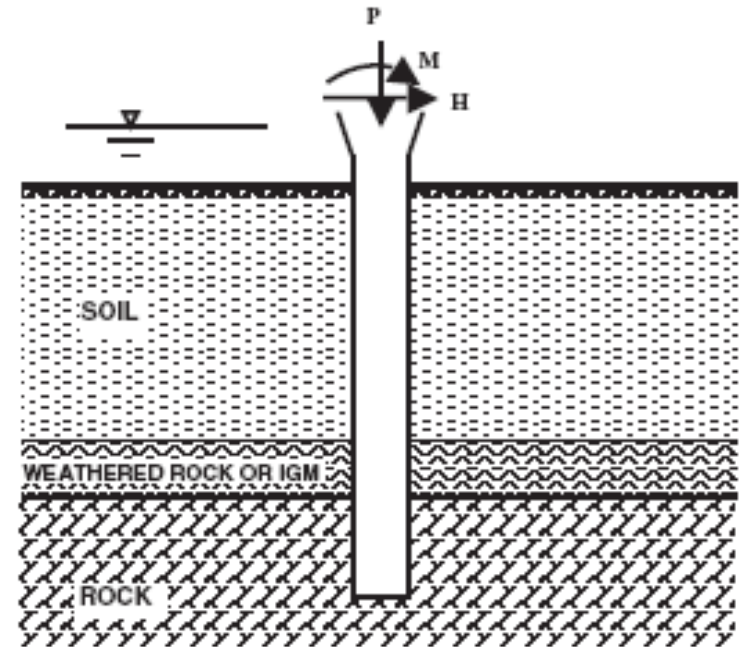
FDOT GRIP

August 15, 2019

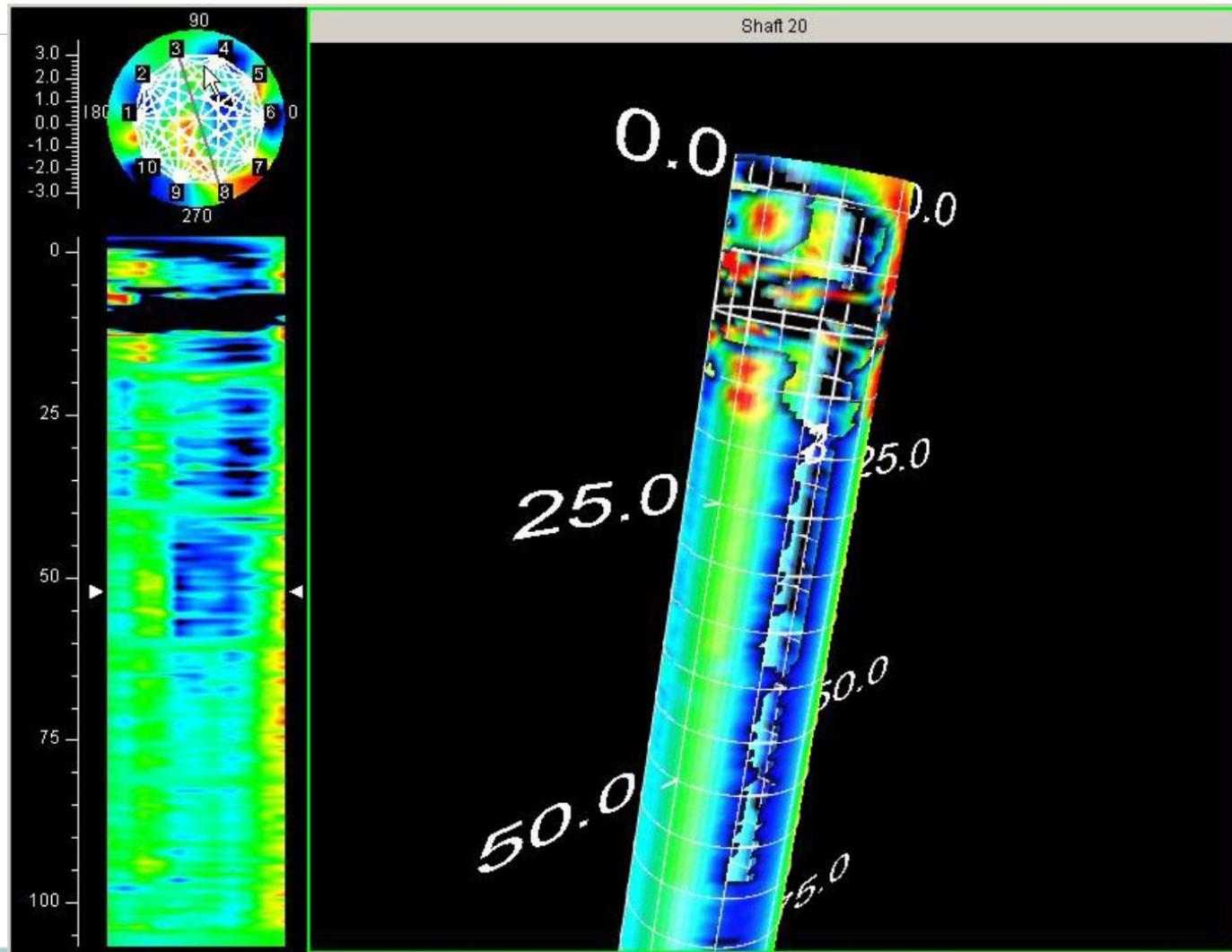


Geophysical Characterization of Rock Sockets

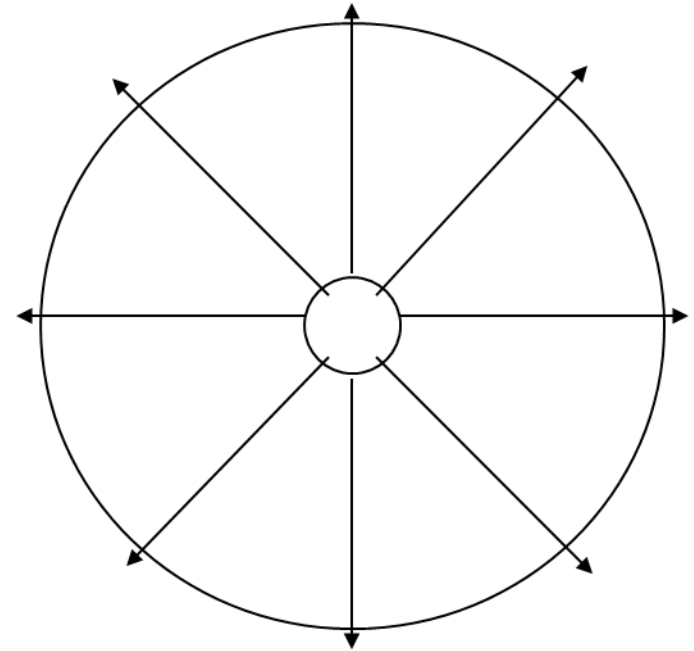
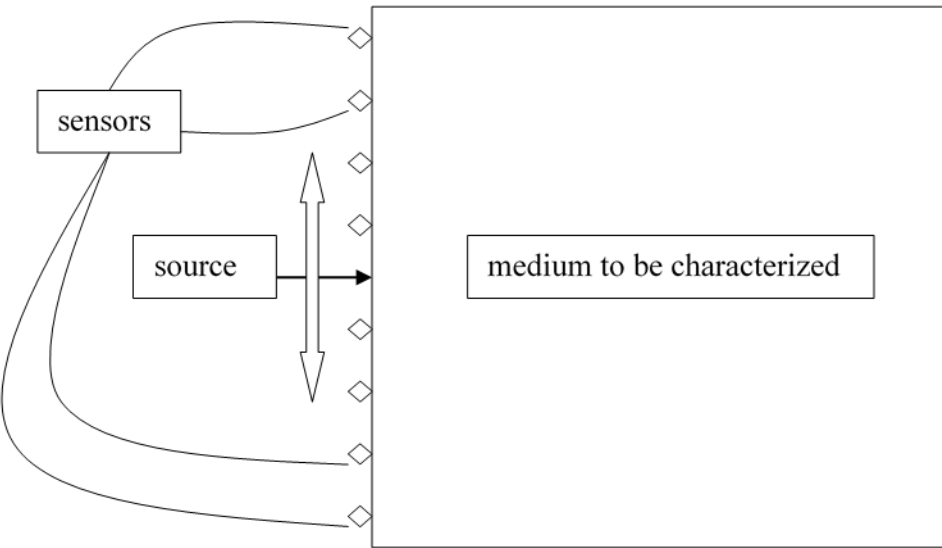
- Rock highly variable: extend characterization to ~5 ft laterally from borehole
- Develop geophysical technique to supplement boring cores and lab results
- Utilize only the one standard borehole
- Integrate with current boring, sampling, and testing tools



Geophysical Characterization of Rock Sockets



Borehole Tool Schematic



A joining of borehole instrumentation with full waveform inversion

Workplan



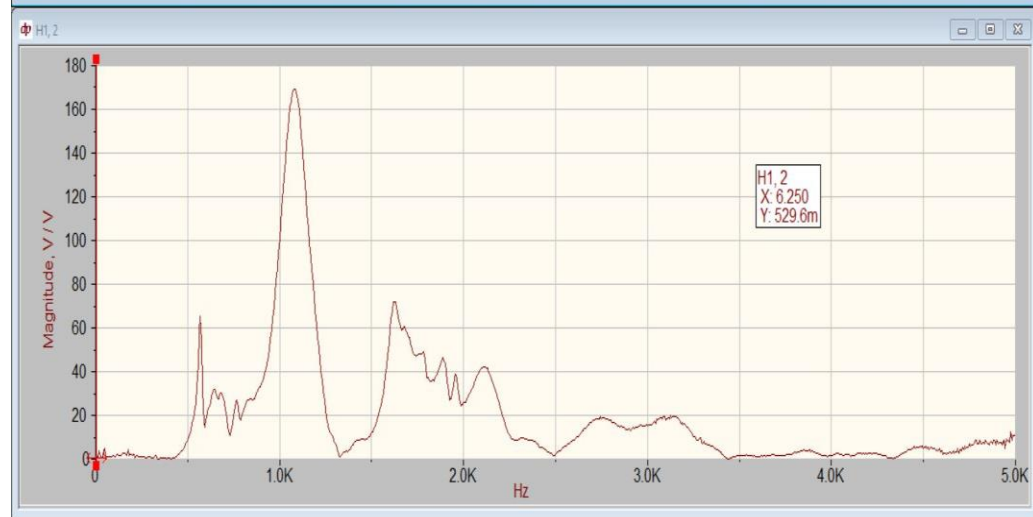
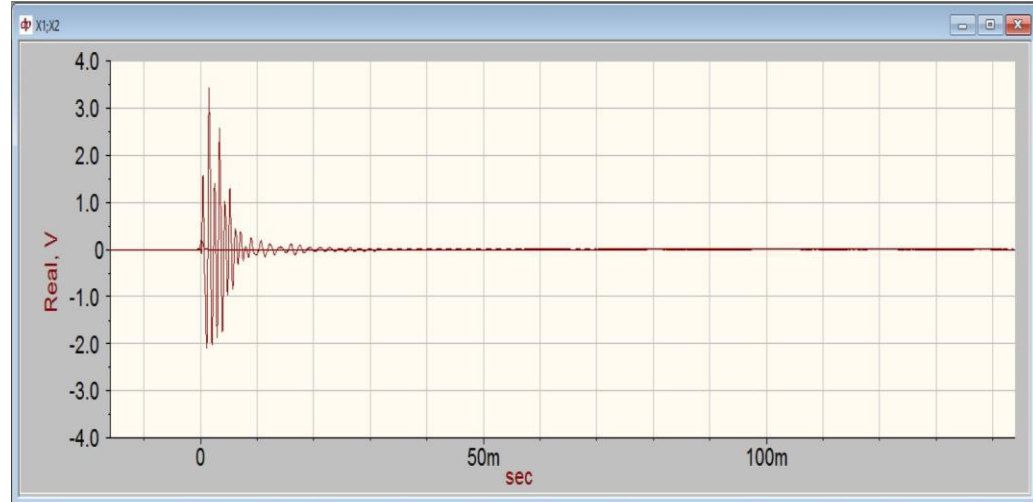
- **Task 1: Borehole Instrument**
 - **Source for generating seismic (mechanical) waves**
 - **Receiver array for capturing the wavefield**
- **Task 2: Inversion Software**
 - **ABAQUS forward model**
 - **Stand-alone forward model for borehole geometry**
 - **Artificial neural network (ANN) trained by ABAQUS**
- **Task 3: Validation Experiments**
 - **Large laboratory block of synthetic limerock**
 - **Newberry and Kanapaha test sites**
- **Task 4: Report**

Recent Activities

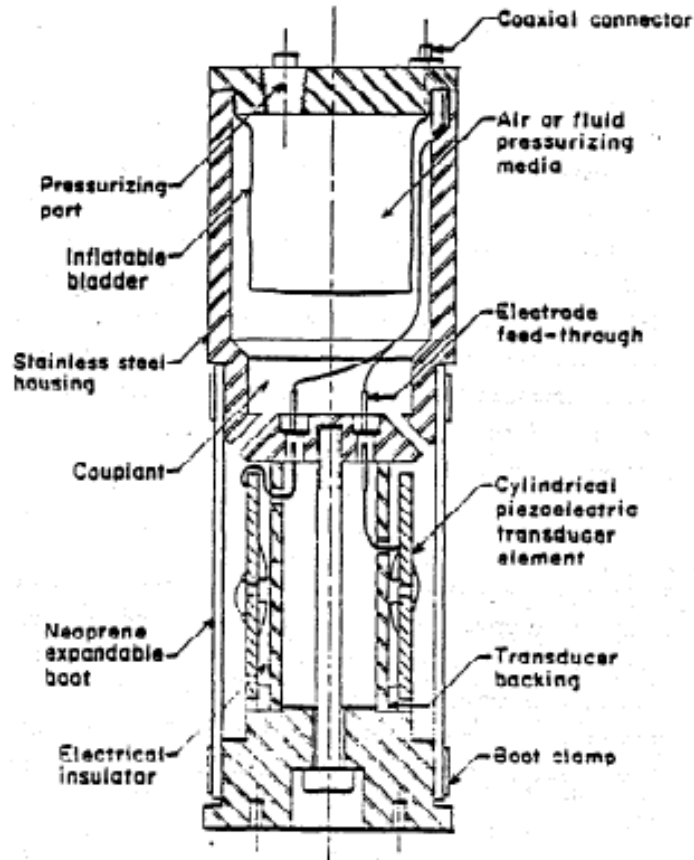
- Tune the source/receiver array to achieve 5-ft penetration: size, spacing, frequency, energy
- Continue development of processing and inversion techniques on data from field experiments



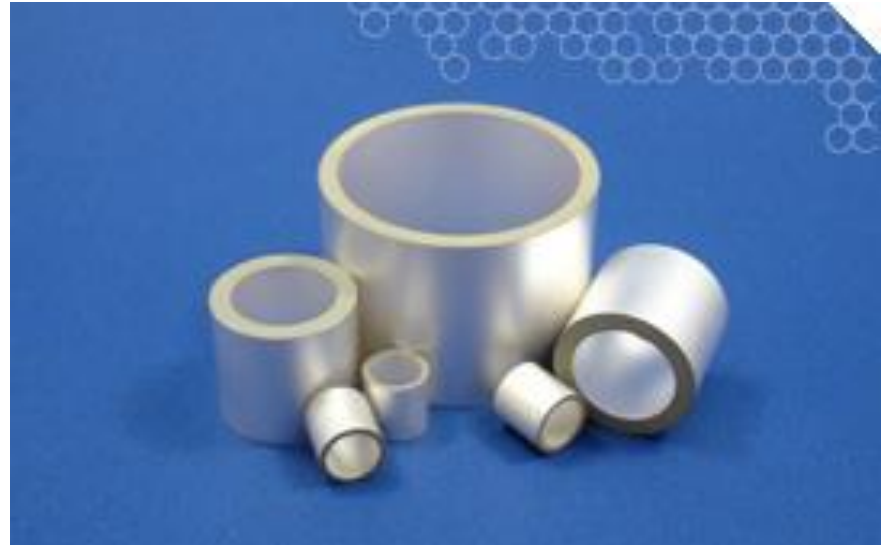
Borehole Receiver



Piezoelectric Borehole Source



Thill (1978)



Piezoelectric Cylinders

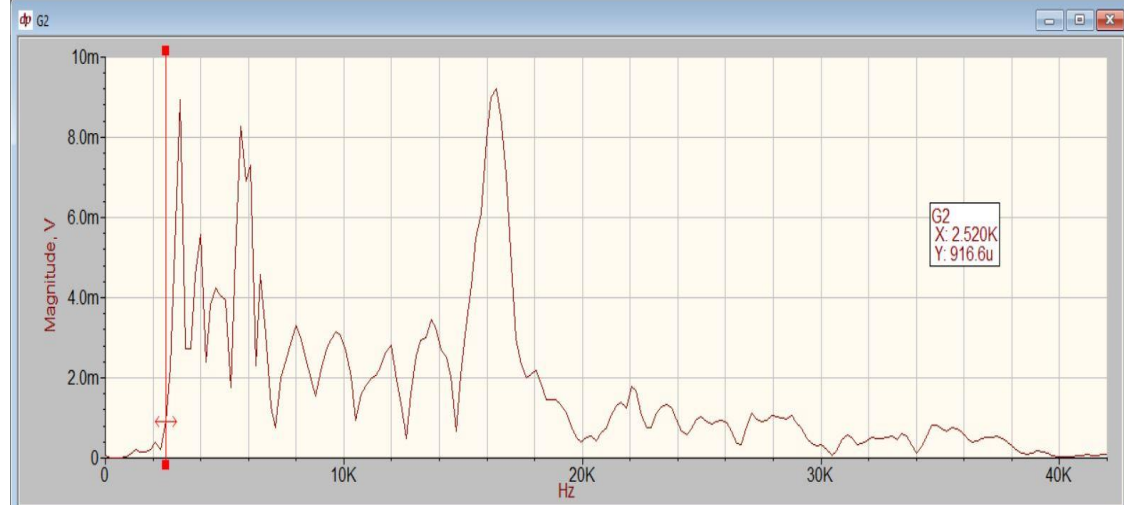
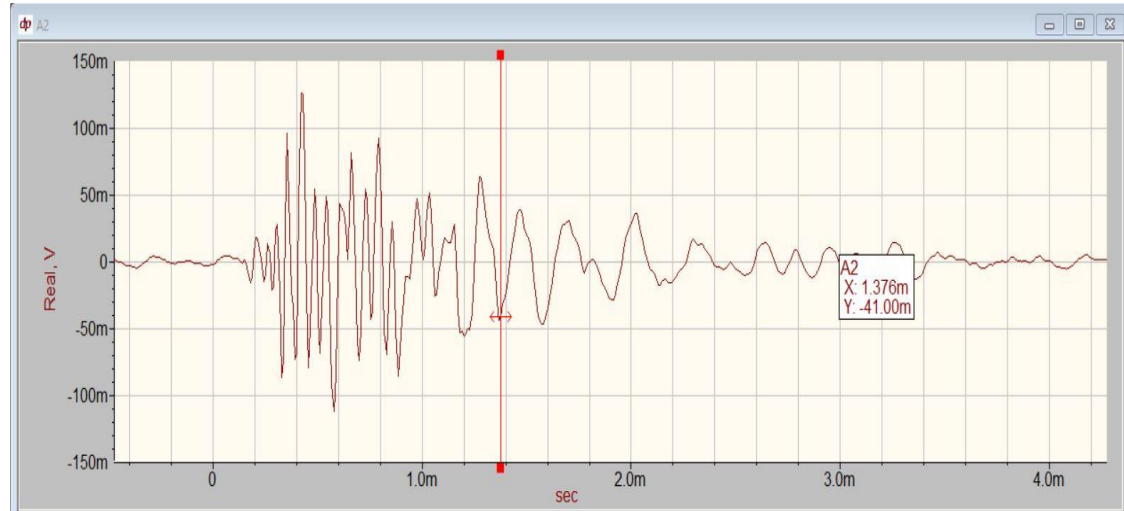
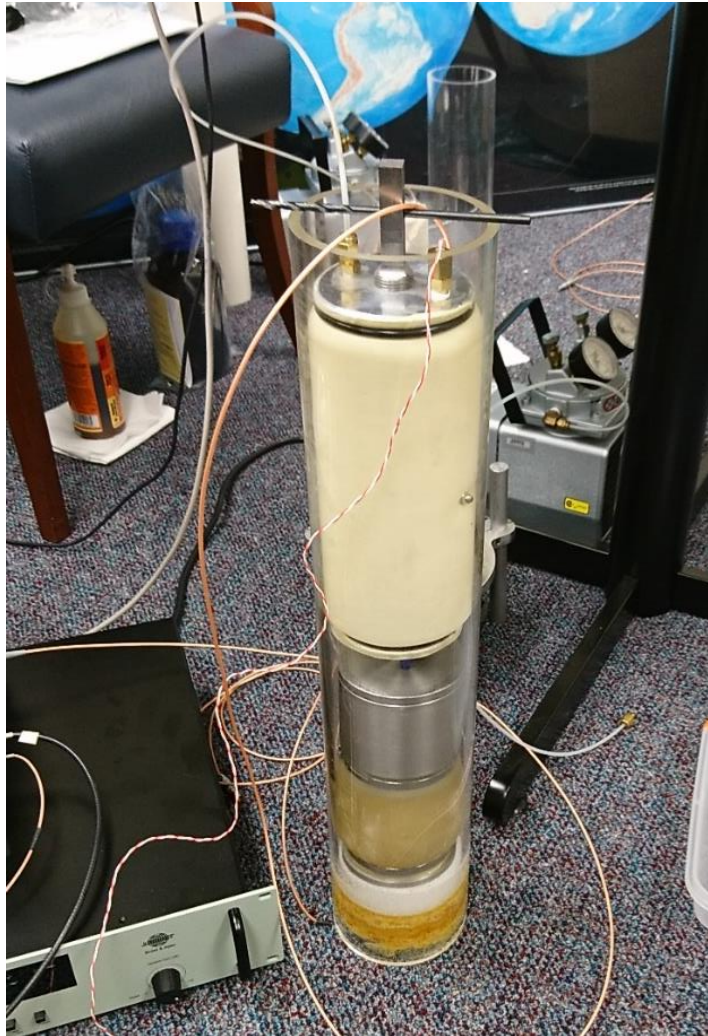


CSL Sensor

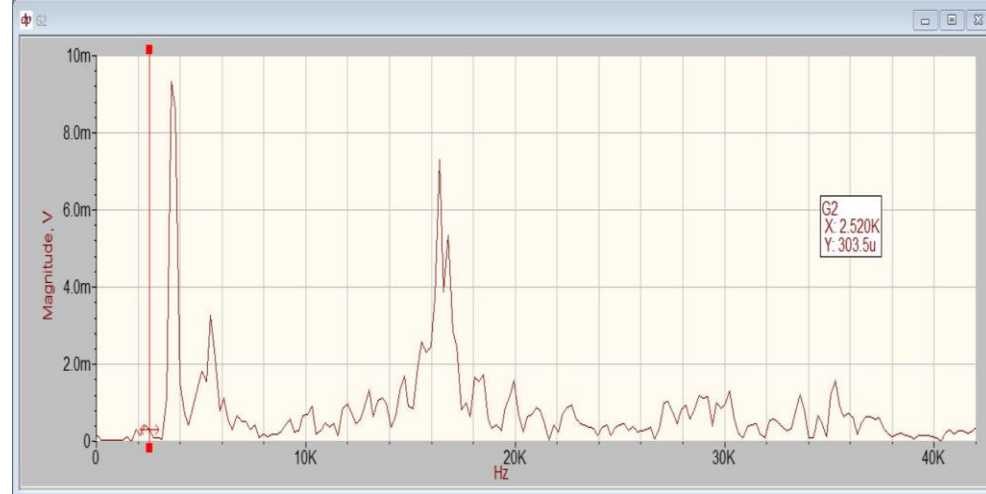
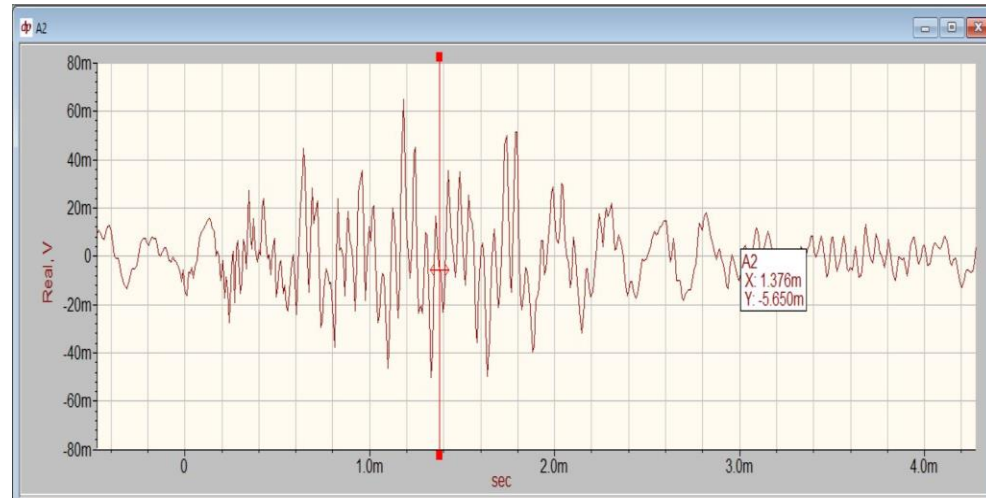
Inflatable Source: Stacked 14 kHz



Inflatable Source and Receiver



Synthetic Limerock Borehole Model



SH Source: Pneumatic (<100 Hz)



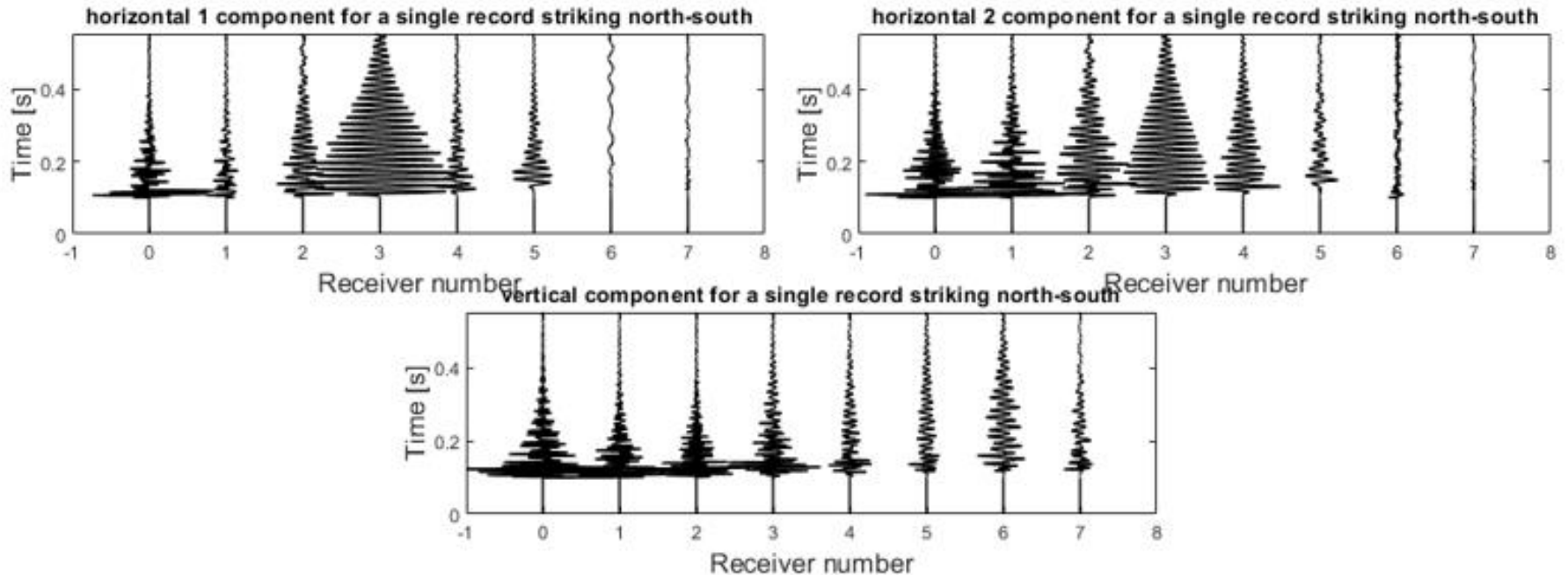
3D Geophone Array



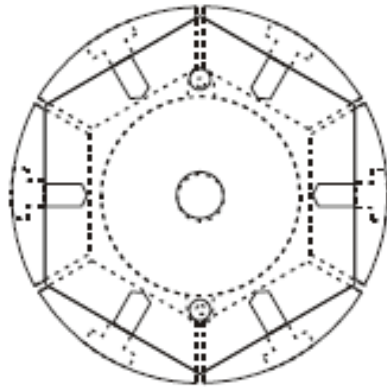
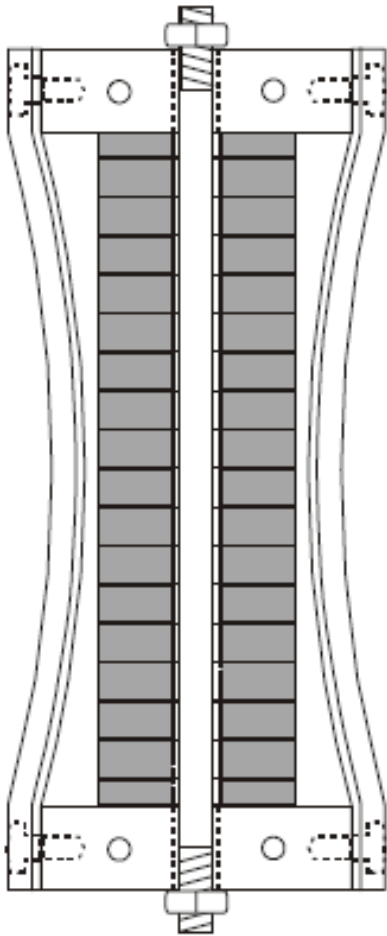
Newberry Experiment



Newberry Experiment



Barrel-Stave Flextensional (>1 kHz)



Future Activities



- **Equip and test barrel-stave transducer in lab and field**
- **Tune the source/receiver array to achieve 5-ft penetration: size, spacing, frequency, energy**
- **Continue development of processing and inversion techniques on data from field experiments**

Thank You!

