ER
ENERGY
RESILIENCY

SUBSURFACE STRESS SIMULATOR (S^3) FOR PRESSURIZED GEOMECHANICAL CORE TESTING

Pacific Northwest
NATIONAL LABORATORY

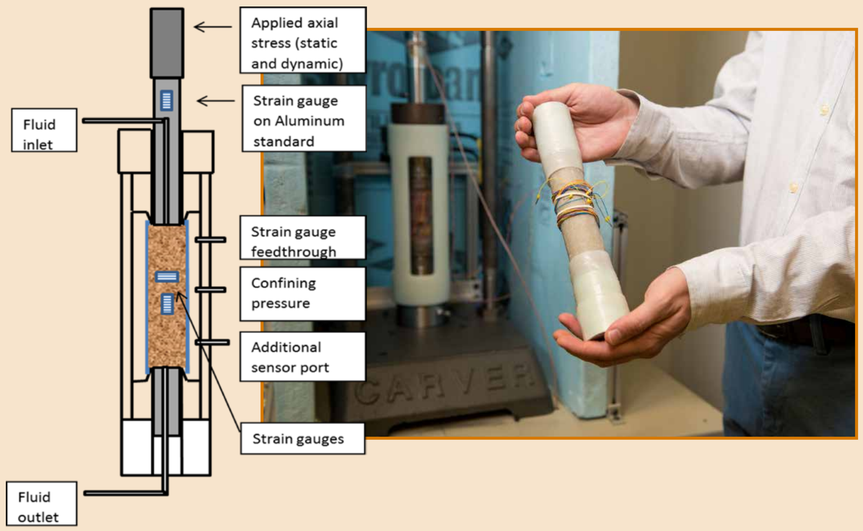
ATOMIC | MICRO | **BENCH** | SYSTEMS | DEPLOYMENT

IMPACT

Simulate subsurface conditions in fluid-saturated rocks to test geophysical monitoring of engineered materials. This flow-through system provides coupled chemomechanical results for the interaction of rocks and fluids at relevant reservoir stresses, pressures, and injectate compositions.

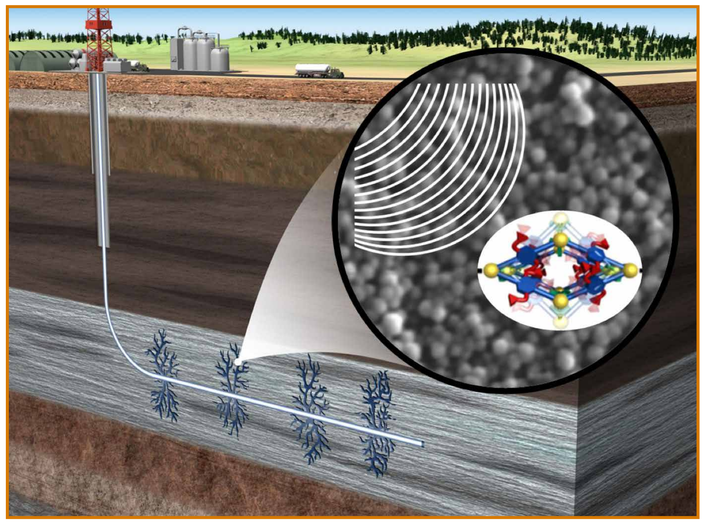
APPLICATION

- Enhanced hydrocarbon recovery and carbon storage
- Optimize fluid injection strategies
- Advanced subsurface monitoring technologies
- Seismic attenuation measurements
- Simulate subsurface confining pressures
- Impose static and dynamic stresses on rock
- Fluid and particle transport through porous media
- Calibrate geophysical models

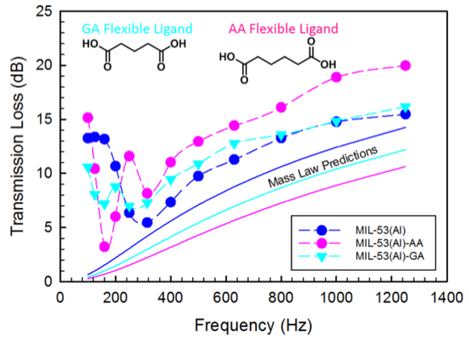


FLEXIBLE AND POROUS SONOCRYSTAL CONTRAST AGENTS

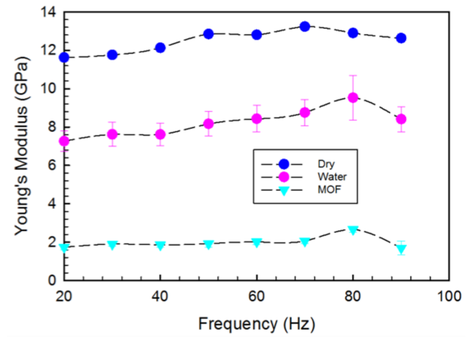
Metal-organic framework nanoparticles may be injected into the subsurface and perform as contrast agents for seismic attenuation geophysical mapping and monitoring. These resonant porous materials can be engineered to be nanoparticles with flexible structures to further enhance their acoustic characteristics. One proposed methodology, to monitor/image subsurface injected CO_2, uses co-injected nanomaterials that respond through two mechanisms: 1) resonant absorption modes stimulated by seismic waves propagating through a subsurface reservoir, and/or 2) alteration of rock stress by fluid interactions at the rock matrix/fluid interface.



Schematic shows structural changes to the flexible metal-organic framework in response to seismic waves. Seismic responses will be used to map fracture networks and track injected fluids.



Framework structures of the Sonocrystals modified with glutaric and adipic acid flexible ligands display additional resonances in transmission loss tests performed with an Acoustic Impedance Tube.



Contrast agent nanoparticles in fluid-saturated sandstone produce measurable diagnostic changes in low frequency seismic attenuation and mechanical properties (Young's Modulus) of the rock.