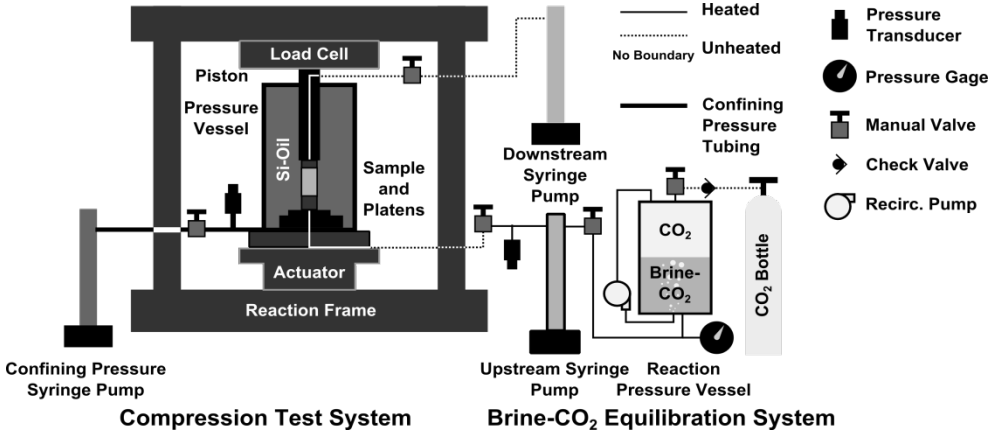
Mechanical variability and chemo-mechanical constitutive behavior of Gulf Coast US Reservoirs

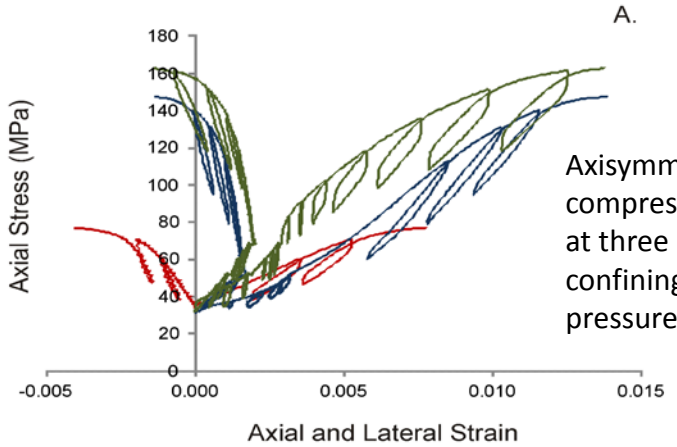
Scientific Achievement

- Performed rock mechanics experiments at *in situ* conditions for Geologic Carbon Storage (GCS)
- Show certain sandstone reservoirs are susceptible to weakening, creep, and fracture resulting from chemical perturbation associated with $scCO_2$ injection
- Developed constitutive model linking elasto-plastic, creep, and fracture response to chemical conditions and reservoir heterogeneity

Significance and Impact

1) Cenozoic and Mesozoic US gulf coast clastic sequences appeal ideal for GSC (injectivity, storage efficiency and security)
2) Explanation for "leak-off" behavior at Seacarb Cranfield injection site
3) Show that chemical manipulation of injectate could provide a viable path for subsurface control of fracture and sustainability of injectivity and sweep





Axisymmetric compression at three confining pressures

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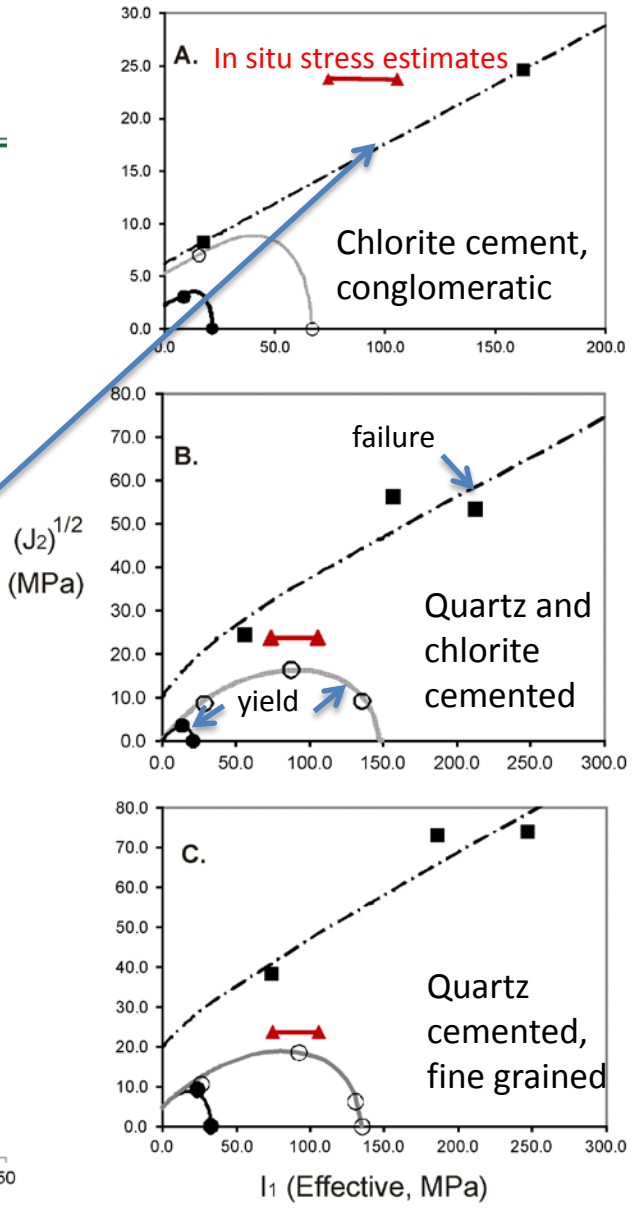
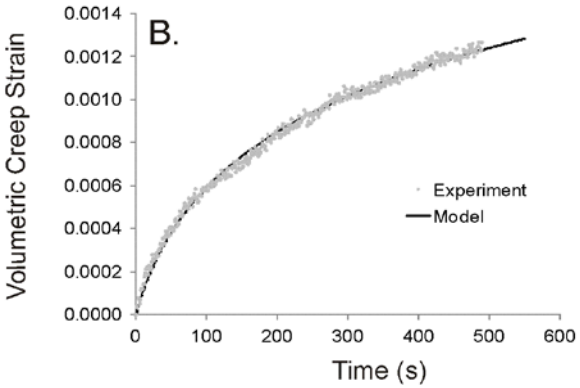
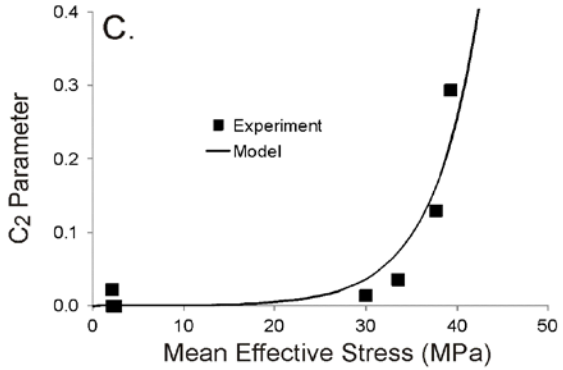
CFSES

CO_2 injection changes deformation behavior of certain rock types or *lithofacies*

- Simulated chemical conditions during scCO2 injection produce heightened creep response, degradation of elastic moduli (and thus seismic velocities), lower yield and failure envelopes for three facies of the lower Tuscaloosa Formation, US Gulf Coast
- Chlorite cemented lithofacies are particularly vulnerable
- Lowered failure envelope can induce a "self-shearing", improving injectivity and sweep efficiency
- Accelerated creep may limit lifetime of shear-enhanced permeability







Primary and secondary creep follow log law with exponential stress dependence

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Mechanical variability and constitutive behavior of the lower Tuscaloosa Formation supporting the SECARB Phase III CO_2 Injection Program, Alex Rinehart, Pania Newell, Scott Broome, and Thomas Dewers, *AAPG Bulletin* **2014** , *submitted*