We study the state and evolution of pressure, stress, deformation, and fluid migration through experiments, models, and field study. We are dedicated to producing innovative concepts that couple geology and fluid flow.

1. Experimental: Analyze fabric, acoustic, electrical, and material properties of mudrocks: 0.1-100 MPa (~15,000 psi).
2. Poromechanical Modeling: Develop/apply coupled models to link realistic rheologies, deformation, stress, and pore pressure.
3. Field Study: Analyze pore pressure, stress, deformation in thrust belts and in the sub-salt.

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GeoFluids Co-Directors
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Professor, Jackson School of Geosciences, U.T.
Jack Germaine
Senior Research Scientist, Civil and Environmental Engineering, MIT

- 13 Graduate Students
- 4 Post-docs & Research Scientists
- 4 Staff/Technical Support

GeoFluids: A team effort of UT Geoscientists and MIT Geotechnical Engineers

Annual Consortium Meeting
Deliverables:
- Online presentations
- Online database with experimental results
- Publications
- Online software
- Spread sheets, handbooks

2013 Consortium Meeting (Feb 21-22)
89 attendees representing 11 different companies

Transferring technology at the annual meeting and resedimentation workshop

Poromechanical Modeling
Geomechanical modeling of stress around salt at Mad Dog

- Elevated horizontal stresses within basins and in front of the salt: 90% to 110% of the overburden.
- Application: predicting pore pressure, stress, and borehole integrity in salt regimes

The Future: Coupled models simulating geological evolution
- Developing a new geomechanical modeling approach that goes beyond current approaches

Salt Diapirs and Sedimentation
We are currently working on modeling salt diapirism and associated pressure and stress evolution

Field Study
Example 1: Fluid Venting in the Ursa Basin
Application—trap integrity and secondary migration
Dip image. Red marks oil slick on surface from radar
Seismic cross section through the Ursa Vent
We use direct measurements of salinity and temperature to quantify the flux of oil and gas expelling from vents.

Example 2: Pore Pressure and Trap Integrity in the Auger Basin
Auger Observations
We characterize geology, pressure, and compaction. The Auger Basin is a ‘protected trap’: the shallowest structure is currently leaking; this allows trap integrity at subsidiary structures (Macaroni and Auger).

Experimental
Resedimentation (making mudrocks in the lab) to understand mudrock behavior
Preparing samples
Consolidation test results
We study how clay composition, pore fluid salinity, and silt content control permeability, compressibility and other material properties. The results are important for pore pressure prediction and basin

New Work: velocity vs. effective stress behavior
- Major current experimental effort is developing ability to measure shear and compressional velocity in mudstones
- Will have direct tie to pressure prediction from log and seismic

Example 2: Pore Pressure and Trap Integrity in the Auger Basin
Vertical effective stress, \( \sigma_v \) (MPa)
\begin{align*}
20 & 18 \\
16 & 14 \\
12 & 10 \\
8 & 6 \\
4 & 2 \\
0 & 0.2 0.3 0.4 0.5 0.6
\end{align*}
Porosity, \( n \)
\begin{align*}
10^{-20} & 10^{-16} \\
10^{-18} & 10^{-14} \\
10^{-12} & 10^{-10} \\
10^{-8} & 10^{-6} \\
10^{-4} & 10^{-2} \\
0 & 0.2 0.3 0.4 0.5 0.6
\end{align*}
Vertical permeability, \( k \) (m²)
\begin{align*}
10^{-12} & 10^{-10} \\
10^{-8} & 10^{-6} \\
10^{-4} & 10^{-2} \\
0 & 0.2 0.3 0.4 0.5 0.6
\end{align*}

Example 1: Fluid Venting in the Ursa Basin
Effective stress ratio K
\begin{align*}
0.3 & 0.5 \\
0.65 & 0.8 \\
1.0 & 0.8
\end{align*}
0.3 0.5 0.65 0.8

Geological evolution
- Developing a new geomechanical modeling approach that goes beyond current approaches

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