

Invitation

NSERC/Energi Simulation Research Consortium

in Reservoir Geomechanics

The Reservoir Geomechanics Research Group, [RG]², is launching the second phase of our research program dedicated to addressing key challenges for reservoir geomechanics with acknowledged support from NSERC, Energi Simulation and several industry sponsors.

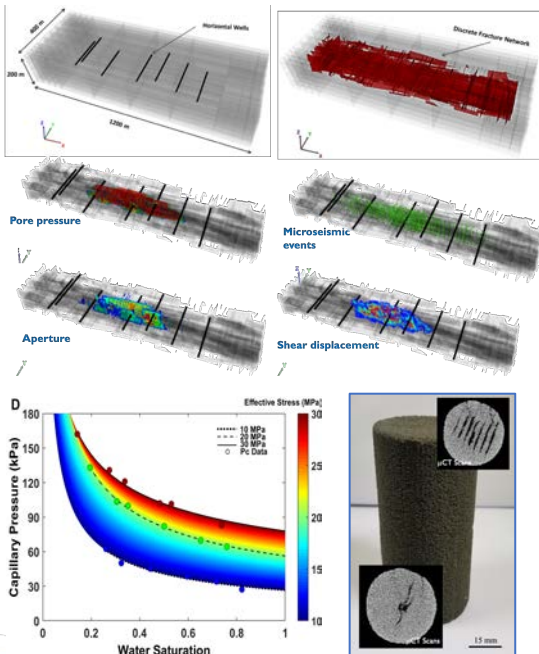
Please join us on Thursday, November 28 from 1:00 until 3:00 pm for a reservoir geomechanics conversation around the research program which is focusing on:

- In situ thermal recovery processes in oil sands; and
- Development of shale/tight oil & gas resources, specifically Montney and Duvernay Formations.

[RG]² will build on our past successes to pursue significant advances in:

- 1) experimental methods that transform our understanding of the complex thermo-hydro-mechanical behavior of unconventional reservoir formations;
- 2) innovative reservoir-geomechanical simulation and modelling approaches; and
- 3) 3D printing technologies for the manufacture of "smart" rocks that will serve as a technology platform for the next generation of experimental investigations of multi-scale, multi-physics reservoir geomechanical processes.

A selection of consortium projects developed within five fully integrated technical themes are illustrated in Figure 1 and Figure 2 provides an overview of our unique GeolInnovation Environments that will underpin the research program.



We look forward to discussing key reservoir geomechanical challenges, setting priorities for our upcoming research program and exploring collaboration opportunities within the Consortium.

Location: UAlberta Calgary Centre
120, 333 – 5th Avenue SW Calgary
Date: November 28, 2019
Time: 1:00 pm to 3:00 pm

Please RSVP to Hope Walls :

Email: hwalls@ualberta.ca or Phone: +1 780 492 3953

To discuss collaboration opportunities, please contact:

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NSERC/Energi Simulation Research Consortium in Reservoir Geomechanics



Theme 1
Pore to Core-Scale Reservoir Geomechanical Behaviour



- Strength-Deformation Behavior from Micro- to Macro-Scale
- Micro to Macro-Scale Tensile Strength Behavior
- Constant Normal Stiffness Shear Behavior of Hard (Mudstones, Siltstones) and Soft Rocks (Caprocks)
- Characterizing Thermo-Hydro-Mechanical Behavior of Heterolithic Sequences in McMurray Formation Oil Sands
- Impact of Deforming Discrete Fracture Networks on Flow (using 3DP Sandstones)
- Impact of Shear Deformations on Relative Permeability and Capillary Pressure in Fractures
- Impact of Shear Deformations on Relative Permeability and Capillary Pressure in Porous Media
- Use of Fully Softened Shear Strength for Consistent Caprock Integrity Assessments

Theme 2
Reservoir Scale Geomechanical Behavior



- Advanced Centrifuge Testing for Factor of Safety Validation
 - Caprock Assessments in the Presence of Faulting
- Role of imbibition in fractured rock mass behavior
- Fundamental Studies to Support RGP3 Deployment in Deep, Sedimentary Rocks

Theme 3
Reservoir Geomechanical Simulation & Modeling



- Impacts of Fracture Property Changes on Rock Mass Behavior and Microseismicity
- Seismic Geomechanics and Induced Seismicity using a Virtual Rock Mass Modeling Approach
- Coupled Hydro-Mechanical Multi-Phase Fluid Flow through Complex Deformable Fracture Systems
- Fast Thermo-Hydro-Mechanical Property Upscaling using Machine Learning

Theme 4
Field-Scale Reservoir Geomechanics Behavior



- Application of Machine Learning Techniques to Interpretation of Pressure Hit Monitoring

Theme 5
Reservoir Optimization w/ Geomechanics




- Geomechanics in Closed-Loop Reservoir Management and Surveillance

Figure 1

Our unique GeolInnovation Environments (GIEs) within [RG]² represent unique, integrated, multidisciplinary university research laboratory environments that will enable breakthroughs in our understanding of constitutive material behavior and our ability in simulating their complex reservoir geomechanical behavior during recovery of unconventional hydrocarbons at multiple scales. Our research team has reservoir geomechanical expertise in reservoir simulation, reservoir surveillance design and implementation, and field services including core preservation and transport, instrumentation design, and experimental programs. Additional information on [RG]² can be found at www.rgrg.ca.

Our GeolInnovation Environments


GeoREF



GeoREF Geomechanical Reservoir Experimental Facility

- Conventional and high temp/high pressure testing systems
 - Triaxial, direct shear, ring shear, oedometer
- Specialized reservoir geomechanical systems
 - Stress-strain dependent permeability
 - Capillary pressure/imbibition
 - Relative permeability
 - Adsorption
- Unique testing environments
 - Mini-triaxial cells - specimens down to 5mm diameter
 - Custom triaxial cell for seismic frequency rock physics testing


GeoPRINT



GeoPRINT 3D PRINTING ROCKS for Reservoir Geomechanics

- Exploring the role of additive manufacturing & 3D printing as a tool for the next generation of experimental investigations of multi-scale, multiphysics reservoir geomechanical processes
- 3D printing of porous media samples with repeatable, realistic geomechanical, hydraulic, and chemical characteristics
- Creation of "Smart Rocks" with embedded sensors to track internal strains and fluid movement within test specimens
- Study impact of geomechanical processes on single and multi-phase flow in fractured media
- Ability to replicate micron-sized features
- 3D laser scanning profilometer for fracture surface replication


GeoRMT



GeoRMT Geomechanical Reservoir Modelling Technology

- Sequentially coupled reservoir geomechanical simulations across multiple platforms
- Constitutive model calibration/development
- Discrete fracture system modelling
- Geomechanical upscaling
 - Application areas:
 - Geological storage of CO₂
 - CO₂-EOR
 - Fault reactivation
 - Hydraulic fracturing
 - Well integrity
 - Underground coal gasification
 - Salt cavern / waste disposal and CAES


GeoCERF



GeoCERF Geomechanical Centrifuge Experimental Research Facility

- Physical modelling using 50g-tonne beam centrifuge
- Caprock integrity testing
- Assessing tailings treatment technologies
- Discrete fracture network modeling using 3D printed analogues

ISERF



ISERF Induced Seismicity Experimental Research Facility

- Experimental facility aimed at generating information to determine if ground motions resulting from induced seismicity are potentially damaging or not (to infrastructure).
- **Pore Scale Research** - Geomechanical experiments on 3D printed rocks wherein novel, innovative radio frequency-based grain-sized sensors are embedded to track both internal displacements and fluid movement while simultaneously measuring the acoustic emission (lab scale induced seismic response) behavior with the specimen. Understanding the fundamentals of rock failure is imperative to understand and mitigate the risks involved in ground motions resulting from induced seismic events.
- **Micro-Scale** - Incorporation of a "shaking table" in GeoCERF will permit us to construct scaled models of shallow formation characteristics, referred to as V₁₀₀, that contain models of the infrastructure of interest (e.g. a bridge abutment, a river slope, a building) and subject them to the ground motions, hence the "shaking," that would result from an induced seismic event.
- **Field Scale** - The multi-channel analysis of surface wave technique (MASW) will be deployed (along with other surveillance technologies) to measure the shear velocity profile of sites within the WCSB.

Research will provide outcomes that aid in de-risking the potential impacts from induced seismicity, either from the hydraulic fracturing activities or from the disposal of waste fluids and help inform governments, industry and regulatory agencies on the development of responsible, effective risk management practices.

Figure 2