Non-Isothermal Reservoir Geomechanical Modeling at Aquistore

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BACKGROUND

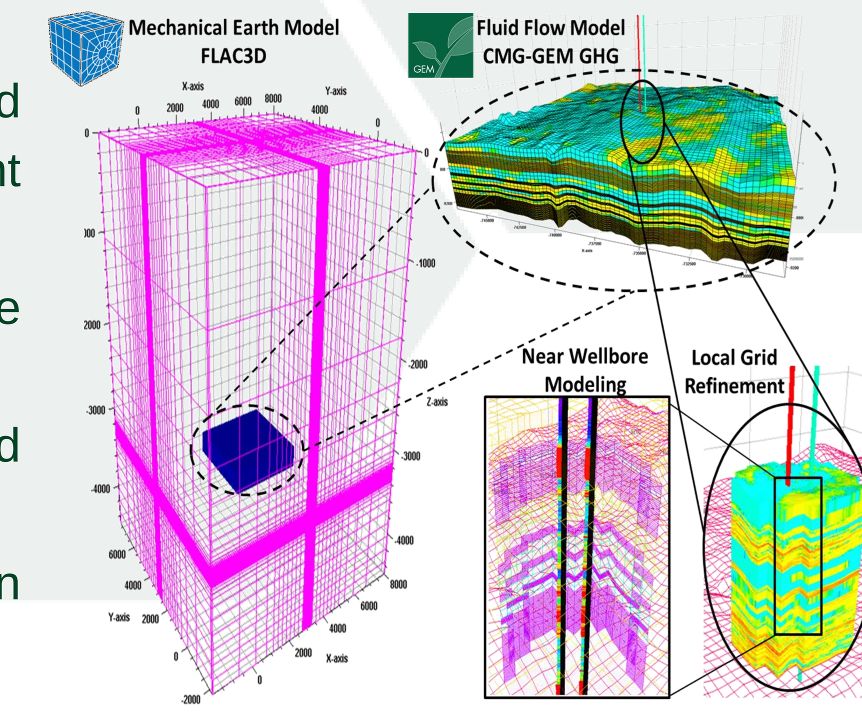
To assess the capacity of Aquistore subsurface formations to receive and safely store CO2 over long periods of time, modeling multiphase flow, heat transport and geomechanical changes that may occur due to CO2 injection, is needed. The injected CO2 will be at lower temperature than the target formation, in liquid or gas state at different depths and less dense than the aquifer water so that the injected CO2 would migrate due to density and pressure gradients.

CO2 injection in Aquistore, sourced from SaskPower's Boundary Dam Power Station, began on April 16, 2015 and approached 100+ ktonnes of injection by 2017. Monitoring data has shown a linkage between injectivity index and downhole injection temperature; however, the mechanism for this effect remains unclear. Understanding this phenomenon is important as it has serious implications on reservoir behavior, caprock, and wellbore integrity.

AIMS AND OBJECTIVES

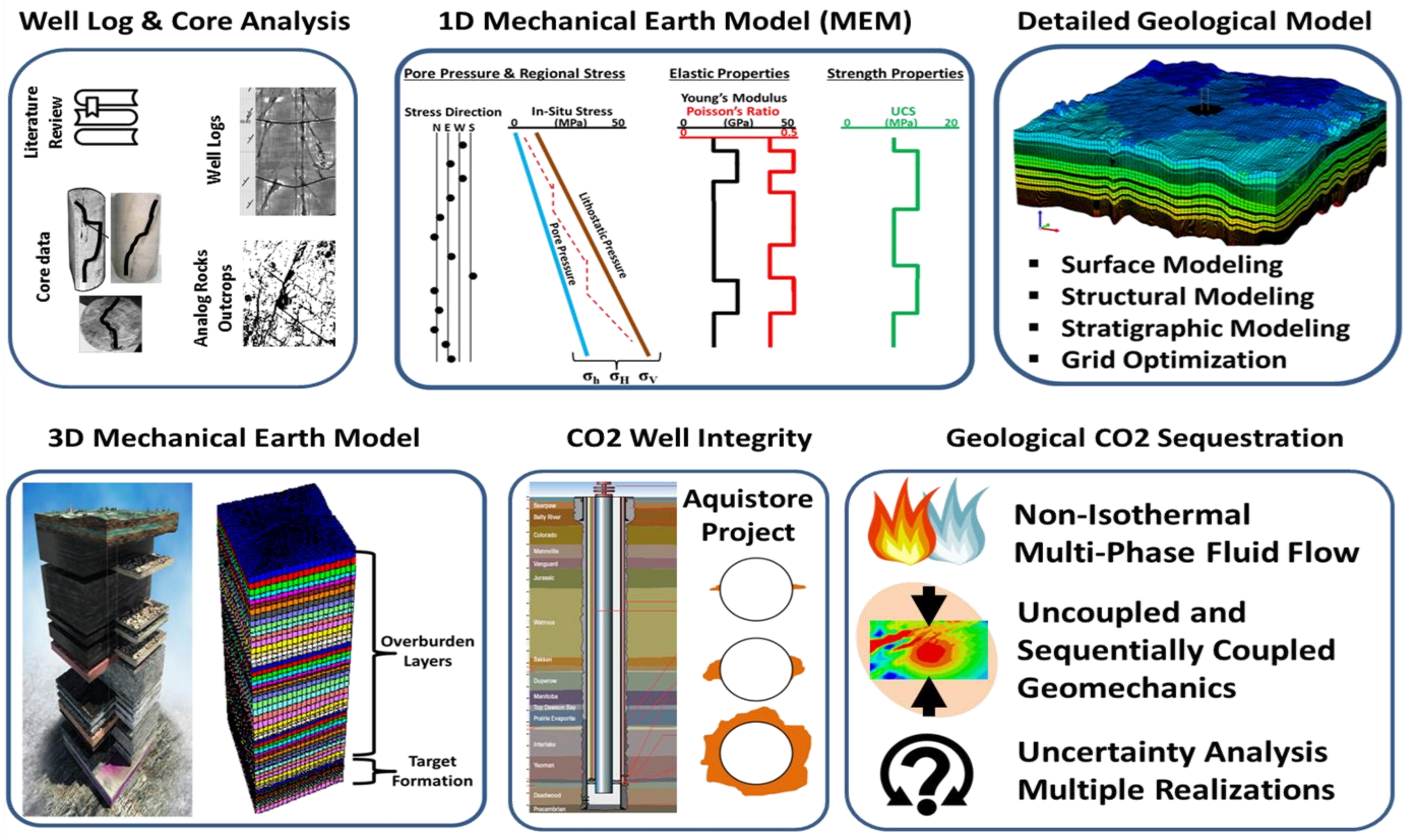
The main goal of this project is to utilize sequentially coupled reservoir geomechanical modeling techniques to investigate the effects of CO2 injection on behavior of the storage formations, taking into account:

- Non-isothermal effect of the injected CO2 lower than the ambient temperature
- Uncertainties in the subsurface geological modeling
- Uncertainties in petrophysical and geomechanical properties
- Uncertainties in CO2 injection process



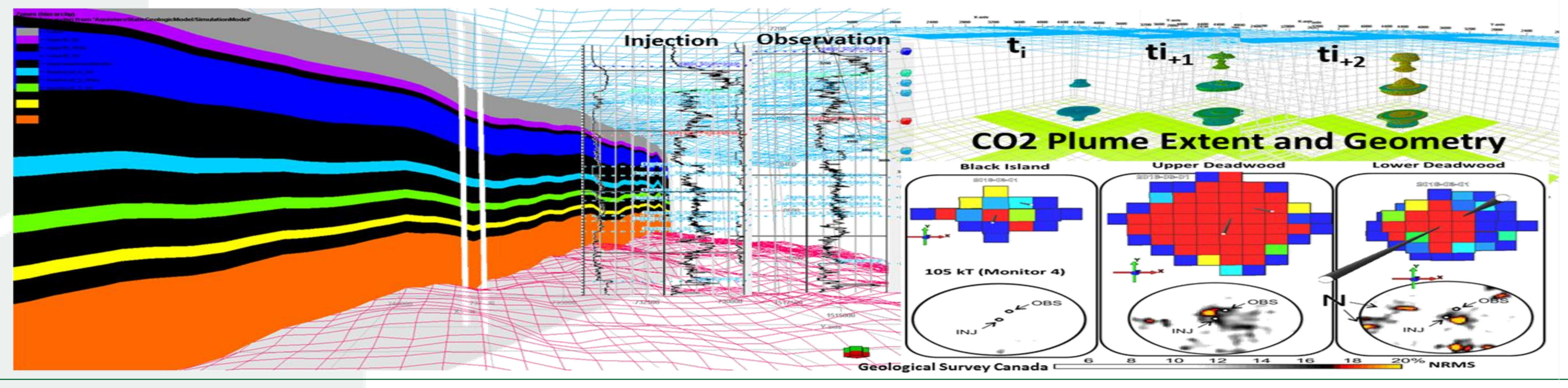
METHODOLOGY OVERVIEW AND RESULTS

- Detailed geological and property modeling obtained from well logs and core analysis,
- Calibrated one dimensional (1D) mechanical earth modeling,
- Calibrated three dimensional (3D) mechanical earth modeling, potentially using 4D seismic,
- Accurate non-isothermal multiphase fluid flow to account for the effects of temperature changes, capillary and viscous forces on heat and fluid transport,
- Coupled numerical simulation platform (non-isothermal multiphase flow and geomechanical simulations) where the calibrated 3D mechanical earth models are used to feed the coupled platform,
- Multiple realizations performed to address the uncertainties associated with the subsurface geological modeling, reservoir heterogeneity, petrophysical and geomechanical properties, wellbore integrity, and CO2 injection process.



FUTURE DIRECTIONS

- Cold CO2 injection
- Subsidence and compaction
- Thermal fracturing and failure modes
- Fault leakage prediction
- Wellbore heat transmission
- CO2 thermo-physical behavior
- CO2 injectivity (mobility)
- CO2 migration in cooled area
- Seismic geomechanics calibration of non-isothermal CO2 plume evolution



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FES PROJECT OVERVIEW

T02-P04: Carbon capture and storage (CCS) is a key technology to enable Canada to meet its 2030 GHG emissions reductions targets. While storage typically accounts for a relatively small fraction of the total cost in a fully integrated CCUS project, it has been shown to be one of the more difficult steps in the project value-chain. Any viable system for storing carbon must be effective and cost competitive, stable as long-term storage, and environmentally benign. Unique aspects of CO2 storage, including containment, regulations, pore ownership, liability, public outreach, and pressure/plume management require large-scale CO2 storage demonstrations to realize this technology.

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