CO_2 induced reservoir storage capacity alteration: rock mechanics

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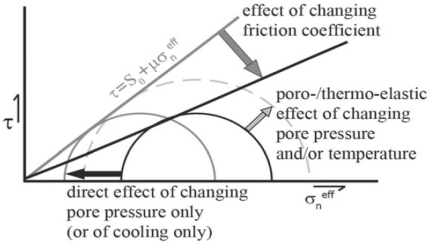
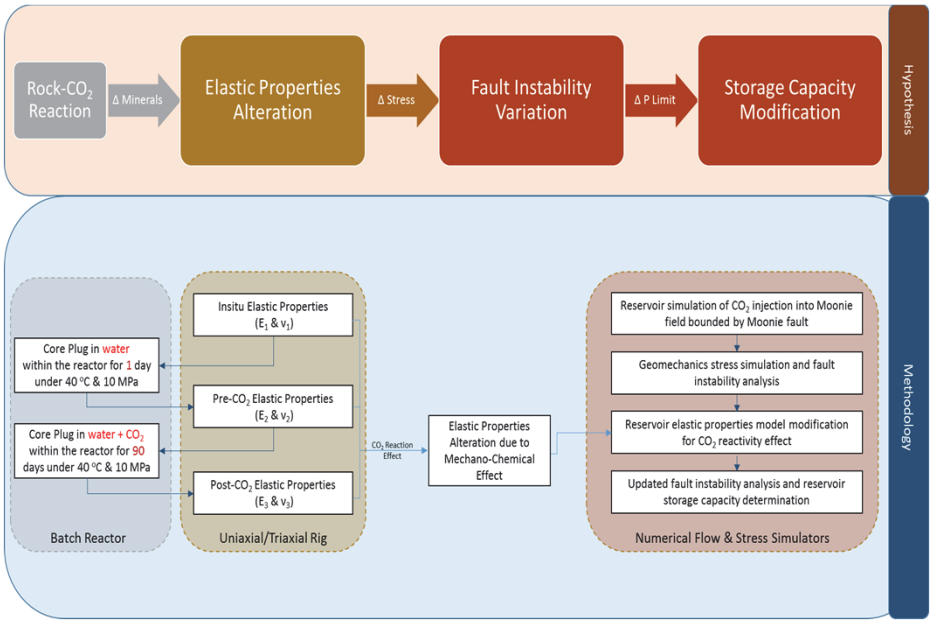
Literature Review:

- Marbler et al. (2012), Masoudi et al. (2013), Rathanweera et al. (2015) and Lyu et al (2016) observed an alteration of elastic properties due to CO_2 reactivity.
- Rathanweera et al. (2015) document a ~20% change in Young's modulus and ~15% change in Poisson's ratio for Hawkesbury sandstone after 4 months of reactivity.
- Factors that affect fault stability:
  - Frictional strength
  - Stress magnitudes
    - i. Pressure change
    - ii. Temperature change
    - iii. Poroelastic effect
    - iv. Mechano-chemical effect



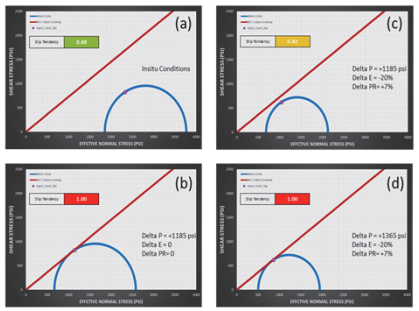


Hypothesis:

Mechano-chemical interactions between CO_2 saturated fluids and reservoir mineralogy could result in variations in the elastic properties of the rock.

This can change the in-situ stress conditions sufficiently to materially affect fault seal integrity and the dynamic storage capacity of the reservoir.

2D – Analytical Fault Instability Analysis



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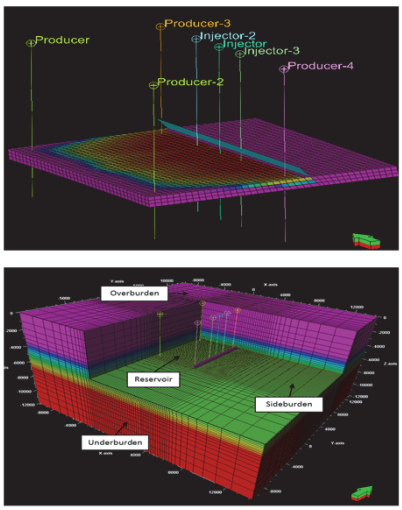
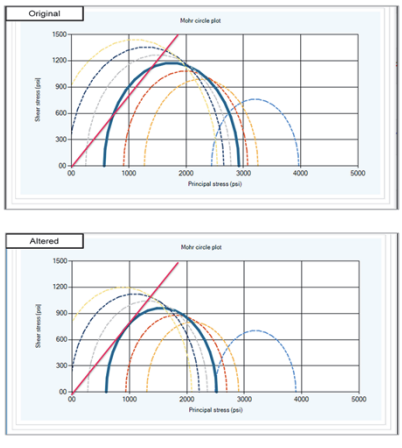
3D - Numerical Conceptual Model



A conceptual 3D reservoir model to simulate the pressure and saturation changes in the reservoir bounded by a sealing fault at one side. Reservoir model embedment into a larger Geomechanics model.

Mechano-Chemical Effect Derived Storage Capacity Modification



Mohr-Coulomb failure analysis for a grid cell next to the fault plane. For the original rock properties scenario the theoretical failure limit reached by year 2023, but for the altered rock properties scenario the theoretical failure limit reached, a year later, by 2024.

20% increase in the storage capacity
of the modelled reservoir due to
20% decrease in Young's Modulus and 15% increase in Poisson's ratio