Towards Making Stress Dependent Multiphase Measurements in Fractures
Da Huo, Sally M. Benson, Department of Energy Resources Engineering, Stanford University

Research Background and Motivation

CO2 Leakage Scenario

1. Faults and fractures strongly influence rock permeability and fluid flow in reservoirs and seals for CO2 sequestration.
2. More accurate permeability, relative permeability and capillary pressure data with changing effective pressure are important to determine the extent that faults and fractures will have impact on leakage behavior.
3. Simulation with considering pre-existing fractures reopening will also be needed to characterize the problem.

Theory

Fracture Aperture Change with Effective Pressure

Calibration

The fracture aperture has linear relationship with CT trough area

\[ Y = 4579 \times \text{Aperture (mm)} + 610.5 \]

The initial aperture is 0.13mm

New Formula

\[ d(\text{mm}) = \frac{\text{CT}_{\text{matrix}} - \text{CT}_{\text{air}}}{\text{R}(\text{mm})} \]

Fracture Aperture

Theoretical CT number distribution

Real CT number distribution

Theory

Conclusions and Future Work

1. Stress-dependent fracture permeability and multiphase behavior is important for a number of applications.
2. Significant consequences of stress dependent behavior.
3. New CT scanning method has been developed and applied in measuring fracture aperture and saturation in fractures.
4. Complex relationship between hysteresis both in aperture and permeability has been observed.
5. Methods for measuring saturation in fractures have been developed and gas injection has been conducted.

References


Acknowledgement

The authors would like to gratefully thank the support of Eni and Department of Energy Resources Engineering, Stanford University.