FALL 2024 PETEROLEUM ENGINEERING SEMINAR SERIES

Class Venue: EN305 | October, 16 2024 | 4:30 - 5:20 p.m.

Kiseok Kim, Ph.D.

Dr. Kim investigates the rock-fluid interactions to the application of Geoenergy systems, leading research in his Geoenergy Systems Laboratory. Employing a multiscale experimental approach, his work aims to understand the multiphysically coupled responses of these systems under in-situ conditions. After completing his bachelors and master's degree from Korea University, Dr. Kim achieved his PhD degree from Civil Engineering – with a focus in rock mechanics, from the University of Illinois. In the fall of 2023, he joined the Petroleum Engineering department at Texas A&M University.

Effect of CO2 injection on the poromechanical and multiphase flow characteristics of subsurface rock

Geologic carbon storage has a great potential in reducing atmospheric CO2 emissions by permanently storing large volumes of carbon dioxide in reservoir formations sealed with tight rock. During CO2 injection, multi-physical processes occur, affecting the mechanical stresses, pore pressures, temperatures, and chemistry of the participating subsurface rocks and pore fluids. These processes are coupled, meaning that changes in each aspect do impact the others mutually. Thus, the interdependent factors need to be understood as a combined system, while it should also incorporate the time-dependent response, as CO2 is projected to be stored for thousands of years. Furthermore, to avoid CO2 leakage through the sealing layers, their poromechanical and hydraulic properties need to be thoroughly addressed. Experimental techniques are introduced to characterize the Poro viscoelastic and hydraulic behavior, including two-phase flow, with CO2 treatment tests conducted under high-pressure conditions. Hydro-mechanical-chemical coupling constitutive model is adopted to address the chemo-poro-viscoelastic response of subsurface rock, with additional studies to explore the impact of the duration of CO2 injection. Ultra-low permeability of the sealing formations is accurately measured in a few month-long experiments and is coupled to the mechanical and pore network characteristics of the rock. In summary, this presentation provides a comprehensive experimental work aimed at characterizing the poromechanical and hydraulic response during CO2 injection, where the chemical effect is also investigated.

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