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The CIVE 6111 Graduate Seminar Series

Reducing Uncertainty of Hydrocarbon Production from Thermally Upgraded Shale: Local Sensitivity Analysis, Data-Worth Analysis, and Inverse Modeling

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2:45PM-3:45PM
Classroom Business Building (CBB) Room 106

Abstract
Organic-rich shale contains organic materials called kerogen, which is an immature hydrocarbon in solid phase. Kerogen produces oil and gas when it is heated to a high temperature around 300 °C. To describe the physical and chemical phenomena accompanied with in-situ heating and hydrocarbon production, a comprehensive numerical simulator has been developed. It describes dynamic changes of system conditions—change of component concentrations by the chemical reactions, phase equilibrium and transitions, fluid and heat flow, and evolution of porosity and permeability.
We perform local sensitivity analysis, data-worth analysis, and inverse modeling, which are coupled with forward numerical simulations, to quantify and reduce the impact of unknown reaction parameters of organic matter decomposition. (1) Local sensitivity analysis provides the most influential unknown parameters on system responses. (2) Data-worth analysis enables the reduction of prediction uncertainty of production, by quantifying relative worth of measurement data. Once we determine the maximum allowable prediction uncertainty and the expected measurement uncertainty, we can figure out the valuable observation data for the minimization of prediction uncertainty. (3) Inverse modeling coupled with temperature transient analysis and thermal skin effect enables the estimation of reactivity using heater temperature transient data, without core sampling and subsurface experiment.

Bio:
Dr. Kyung Jae Lee is an Assistant Professor in the Department of Petroleum Engineering at University of Houston. Before she joined the University of Houston in September 2017, she was a Geological Postdoc Fellow in the Energy Geosciences Division of Lawrence Berkeley National Laboratory. She holds a PhD in petroleum engineering from the Texas A&M University, a MS in energy system engineering, and a BS in energy resources engineering from the Seoul National University of Korea. Her research interests include:

- Numerical and theoretical research on fluid transport and heat flow in porous/fractured media
- Modeling of unconventional hydrocarbon reservoirs—oil shale, shale gas, methane hydrates, heavy oil, bitumen
- Forward simulation and inverse modeling of diverse processes applied in subsurface energy systems—chemical/thermal enhanced recovery, in-situ upgrading, cyclic steam stimulation, hydraulic fracturing, CO_2 sequestration, CO_2 push-pull
- Applications—economic production of unconventional resources, environmental effects of hydrocarbon production, control and protection of groundwater, enhanced geothermal systems