CEE AT ILLINOIS
Department of Civil and Environmental Engineering

GESO
GEOTECHNICAL ENGINEERING STUDENT ORGANIZATION AT UIUC

CEE 595F – Geotechnical Engineering Seminar

Friday, March 29th, 2019 | 11:00 AM, Newmark Lab 3310

Impact of Multiscale Heterogeneity on Mechanical Behavior of Mancos Shale

Hongkyu Yoon
Geomechanics Department, Sandia National Laboratories, NM

Abstract: The performance of unconventional resources reservoir is a function of the hydro, mechanical, and chemical properties of shale formations with compositional and textural heterogeneity across a range of scales. In particular, mechanical properties (elastic properties, fracture toughness, anisotropy, etc.) are controlled by a variety of geologic variables, including mineralogy, cements, and organic content, and the spatial distribution of these characteristics. In this work integrated approach of multiscale imaging, mineralogy distribution, nano-indentation, and numerical simulations is employed to investigate the impact of the micro-lithofacial heterogeneities on pore structure and mechanical properties for Cretaceous Mancos Shale, a thick mudstone with widespread occurrence across the western interior of the USA. Detailed petrographic analysis, axisymmetric compression, indirect tensile strength testing, and nano-indentation measurements at the micron scale show the effect of composition, texture phases, and interfaces of phases on mechanical properties. Variations in micro-lithofacies are first-order factors in determining the mechanical response of this important Mancos constituent, and are likely responsible for its success in hydrofracture-based recovery operations as compared to other Mancos lithofacies types. This work allows us to make more accurate prediction of reservoir performance by developing a multi-scale understanding of mudstone response to reservoir stimulation efforts.

Speaker Bio: Dr. Hongkyu Yoon obtained a Ph.D degree in Environmental Engineering from the University of Illinois at Urbana-Champaign in 2005. After working as a research scientist at UIUC, he joined the Geomechanics Department at Sandia in 2010 and currently a principal member of technical staff. He is an expert in hydrogeology and fluid mechanics, microfluidic and flow cell experiments, characterization of pore topology, chemo-mechanical processes of nano-porous geomaterials using multiscale imaging techniques, and high-fidelity inverse modeling, specializing in applications of coupled hydrogeological, geomechanical, and geochemical processes. His recent research focuses on induced seismicity during subsurface energy activities (e.g., CO2 sequestration, unconventional oil and gas recovery, and geothermal recovery), machine learning/deep learning applications for subsurface material characterization and multiscale simulations, coupled thermal-mechanical-hydrological-chemical processes with applications to subsurface energy technologies, and geomaterial (shale, carbonate rocks, salt, clay) characterizations with multiscale imaging and mechanical testing. Recently he pioneered applying 3D printing techniques for fluid flow and mechanical behaviors on 3D digital rock structures and their applications for upscaling.