Geophysical Research Abstracts
Vol. 20, EGU2018-11613, 2018
EGU General Assembly 2018

Intermediate Scale Testing for Non-traditional Problems in Subsurface Science and Hydrology

Tissa Illangasekare (1), Andrew Trautz (1), Luca Trevisan (2), Elif Agartan (1), Mike Plampin (3), and Stacy Howington (4)

(1) Colorado School of Mines, Center for Experimental Study of Subsurface Environmental Processes, Civil and Environmental Engineering, Golden, United States (tissa@mines.edu), (2) Karlsruhe Institute of Technology – Institute for Hydromechanics, Institut für Hydromechanik Kaiserstr.12 D-76131 Karlsruhe, Germany (luca.trevisan@kit.edu) , (3) U.S. Geological Survey, 2201 Sunrise Valley Drive Room 5B304, MS432 Reston, VA 20192, USA (mplampin@usgs.gov), (4) U.S. Army Engineering Research and Development Center (ERDC), Vicksburg, MS, USA (Stacy.E.Howington@erdc.dren.mil)

Multi-scale testing and modeling have been used in subsurface research to improve fundamental process understanding and to obtain new insights into upscaling theory. The intermediate scale, a length scale that is intermediary to the traditional laboratory and field scales, is a part of this experimental approach. Limited measurements and a lack of control make the validation of flow and transport theories and predictive models using field data difficult. Intermediate-scale, physical models provide cost-effective alternatives that allow accurate, high-resolution datasets to be generated across a range of observational scales under carefully controlled conditions. Emerging problems related to climate change and food-water-energy nexus security (e.g., carbon dioxide sequestration, fugitive methane loading during unconventional energy development, ecohydrology, irrigation management) do not fall within the traditional scope of subsurface hydrology, thus warranting further investigation. Adapting intermediate scale testing to such non-traditional problems pose many scientific and technical challenges in how to create appropriate atmospheric boundary conditions and reproduce multiphase fluid flow behavior characteristic of the high pressures of deep geologic formations. This paper presents our recent work on the development and application of intermediate scale test systems to address these non-traditional problems. Experimental techniques and results are presented from studies involving: enhancing capillary trapping of supercritical carbon dioxide, dissolution trapping of carbon dioxide in heterogeneous formations, the leakage of gases from deep geologic formations and evaporation from bare and vegetated soils. The practical implications of these findings are discussed.