**Advancing Models for Multiphase Flow in Porous Media**

James E. McClure, Amanda L. Dye, Mark A. Berrrill, William G. Gray, and Cass T. Miller

Advanced Research Computing at Virginia Tech, 3050 Torgersen Hall, Blacksburg VA, 24061

Phone: (540) 231 1365; Email: mcclurej@vt.edu

**Abstract**

Multiphase flow processes in the subsurface are fundamentally important for many applications including a wide range of hydrologic processes, geological carbon sequestration and emerging energy recovery technologies such as hydraulic fracturing. Mathematical models that describe these complex processes have long relied on empirical approaches that neglect important aspects of the system behavior. New data sources now make it possible to directly measure previously inaccessible information and access the true geometry of geologic materials. This information can be exploited to support a new generation of theoretical models that are constructed based on rigorous multiscale thermodynamic and continuum mechanical principles. We show how information from microfluidics and synchrotron-based X-ray micro computed-tomography can be used to inform models that can account for interfacial dynamics and other aspects of multiphase flow in porous medium systems. We also consider how this approach can be applied to address long-standing challenges related to subsurface heterogeneity.