

Noninvasive Imaging of Processes in Natural Porous Media: From Pore to Field Scale

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Characterization and prediction of flow and transport processes in natural porous media are required for sustainably managing water- and soil resources in the face of intensifying levels of climate change, food and fiber production, CO₂ sequestration, waste disposal, etc. Due to the opaque nature of natural porous media, developing three-dimensional spatial information on states, properties, and fluxes requires the application and further development of modern imaging techniques that have rapidly evolved in recent years. These methods include magnetic resonance imaging (MRI) for high-resolution visualization of pore geometry, fluid distribution, and flow of nanoparticles or other tracers in column-scale studies; land-surface based nuclear-magnetic resonance (NMR) techniques applied in field-scale studies; laboratory based X-ray computed tomography (XRCT) for high-resolution imaging of the solid matrix and embedded fluids; and neutron tomography (NT) for imaging multi-pore scale features using neutron absorbance for systems too low in contrast for X-ray tomography. This special issue also will include hydrogeophysical techniques such as electrical resistance tomography (ERT) and electrical inductance tomography (EIT), which produce images of electric-conductivity and impedance structures for laboratory to field-scale applications; ground penetrating radar (GPR), which produces detailed information on field soil-water-content, dielectric-permittivity, and electrical-conductivity structures; and electromagnetic induction (EMI) tomography, which produces images using the eddy current effect.

This special issue welcomes research contributions in these and related areas (such as seismic tomography), as we review the existing state-of-the-art and present original advances in the field using imaging techniques individually and in combination for laboratory and field-scale investigations.

(In conjunction with the special issue we are planning a workshop on these topics for fall 2016, which will be announced separately. Papers presented at the workshop can be included in the special issue after passing through the standard journal-review process.)