Petrophysical studies of unconventional gas reservoirs using high-resolution rock imaging

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OBJECTIVE
Investigate the physical mechanisms that limit gas recovery from tight rock formations to allow long-term gas recovery

MOTIVATION
Unconventional production is the largest source of U.S. natural gas supply // U.S. EIA Annual Energy Outlook 2009 with Projections to 2030

U.S. estimated shale, tight sand, and CBM gas resources: over 8,000 Tcf // Holditch S.A.: SPE 103356

U.S. gas consumption: 22 Tcf / year // U.S. EIA

APPROACH
Acquire high-resolution 3D images of gas-bearing shale rocks using

- Advanced Light Source (ALS) microtomography facility
- Focused Ion Beam (FIB) technology,

Analyze these images using Maximal Inscribed Spheres-type (MIS) methods in order to estimate gas shale and tight sand flow properties at different conditions

Apply the results to modeling of the impact of retrograde condensation at the fracture-matrix interface on the gas flow into the well

MICROTOMOGRAPHY

Schematic layout of the microtomography end station at the ALS

MIS SIMULATIONS

Gas

Water

S_w = 24%

Gas

Water

S_w = 45%

Gas becomes disconnected at moderate (<50%) water saturation

FIB

- 3D reconstruction
- 20-nm voxel size

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