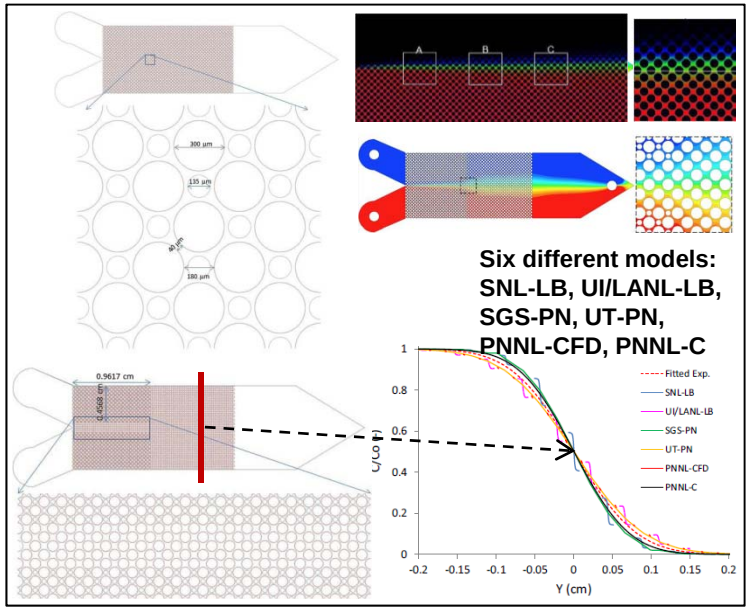
Pore-scale simulations of solute transport micromodel benchmark experiments



(Left) Micromodel configuration of different pore structures including post, pore-throat, and pore-body. Total four different structures were tested. (Upper right) Measured concentration image (top) and a simulated concentration distribution (bottom) (Lower right) Experimental and numerical concentration profiles along the transect.

Oostrom and Mehmani et al., Pore-scale and continuum simulation of solute transport micromodel benchmark experiments. Comput Geosci, on line, (2014)

Work was performed at Sandia National lab (H. Yoon, T. Dewers) and UT-Austin (Y. Mehmani, M. Balhoff) as part of CFSES

Scientific Achievement

Developed a computationally efficient pore network (PN) model and validated both PN and more robust pore scale models against experimental results

Significance and Impact

Improved the computational efficiency and accuracy of pore-scale transport models for developing coupled reactive transport systems perturbed by geological carbon storage

Research Details

- A newly developed pore-network transport model developed at UT-Austin was used to simulate four sets of benchmark non-reactive transport experiments in microfluidic pore networks which were led by the Pore-scale Modeling Research Campaign at the EMSL–DOE BER user facility
- A robust lattice-Boltzmann finite volume method developed at Sandia is one of five pore-scale models tested
- All five pore-scale models were able to capture concentration profiles with varying degrees of computational efficiency and accuracy
- The experimental setup and models tested in this study allow us to develop more robust and computationally efficient pore-scale reactive transport methods for improving our predicability of reactive transport processes during geological CO_2 storage

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Table 3 Overview of used models and institution affiliations

Name	Institution	Numerical method for fluid flow	Numerical method for solute transport
SNL-LB	Sandia National Laboratory	Lattice Boltzmann	Finite volume
UI/LANL-LB	University of Illinois and Los Alamos National Laboratory	Lattice Boltzmann	Finite volume for Exp. I-c, II-c, and III-c. Lattice Boltzmann for Exp. IV-c
SGS-PN	Shell Global Services	Pore network	Pore network
UT-PN	University of Texas	Pore network	Pore network
PNNL-CFD	Pacific Northwest National Laboratory	Computational fluid dynamics—finite volume	Computational fluid dynamics—finite volume
PNNL-C	Pacific Northwest National Laboratory	(Continuum) Integrated finite difference	Total variation diminishing scheme

Oostrom et al. (2014)