Small Internal Pores in Soil and Geologic Materials Influence the Biogeochemical Behavior of Larger Environmental Systems

Challenge

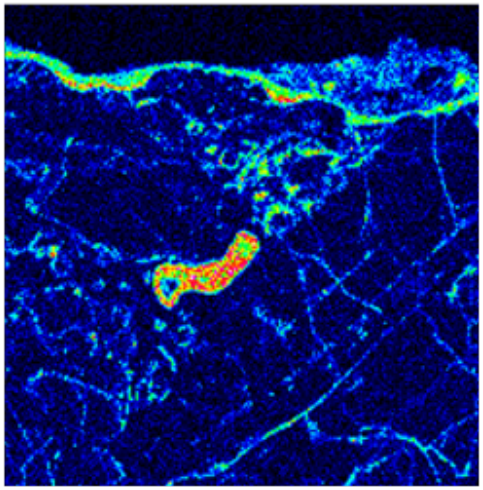
- Soil and geologic material reactivity is dominated by internal pores of highly varied size distribution, structure, connectivity, and biogeochemical composition. Smaller pores dominate reactive surface area, but their properties and reactivity are poorly understood because of long-standing characterization limitations.

Approach and Results

- We performed a critical evaluation of 1) sensitivity, merits, and limitations of recently developed pore characterization methods, with emphasis on 3D imagery enabled by EMSL and BES user facilities, and 2) new findings on the presence or absence of unique behaviors in small pores.
- Modern methods allow 3D imaging of internal pores and their chemical compositions and network structures to ~50 nm. Pore network connectivity and topology are key factors controlling environmental system reactivity at larger scales.

Significance and Impact

- New, more sensitive imaging methodologies are providing increasing detail on the physical and chemical structures of environmental mineral and organic materials allowing development of mechanistic understanding and reaction models.



X-ray microscopy of a porous rock fragment reveals the distribution of connected channels and pores shown in green, yellow, and red.

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Reference: Zachara, J.M., S. Brantley, J. Chorover, R.P. Ewing, S. Kerisit, C. Liu, E. Perfect, G. Rother, and A.G. Stack. 2016. "Internal domains of natural porous media revealed: Critical locations for transport, storage, and chemical reaction." *Environmental Science & Technology,* Accepted. DOI: 10.1021/acs.est.5b05015