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RUI ZHANG, Ph.D.

Associate Research Scientist – Geoscience, Energy & Nanostructured Materials
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EDUCATION

Ph.D., Energy and Mineral Engineering December 2018
Pennsylvania State University, University Park, PA
Dissertation title: "Investigation of Pore Structure and Sorption Behavior for Unconventional Gas Reservoir Rocks"
Committee*:* Shimin Liu (chair), Lilin He, Derek Elsworth, Demian Saffer, Hamid Emami-Meybodi

Master of Science, Petroleum Engineering December 2015
Pennsylvania State University, University Park, PA
Thesis title: "Methane and Carbon Dioxide Adsorption Capacity Estimation and Modeling on Coals"
Committee*:* Shimin Liu (chair), Derek Elsworth, Mark S. Klima

Master of Engineering, Petroleum and Natural Gas Engineering June 2013
Southwest Petroleum University, Chengdu, Sichuan, China
Thesis title: "Hydraulic Fracturing Technology Optimization in Zheng Zhuang Block of Yanchang Oil Field"
Faculty advisor: Jianchun Guo

Bachelor of Engineering, Petroleum Engineering June 2010
Southwest Petroleum University, Chengdu, Sichuan, China
Thesis title: "The Experimental Study of Fluid Leakoff in the Glutenite Reservoir"
Faculty advisor: Shibin Wang, Zhihong Zhao

EXPERIENCE

Associate Research Scientist July 2023 – present
Eyring Materials Center, Arizona State University, Tempe, AZ

- Responsible for **technical leadership, operation, maintenance, and advanced applications** of several very advanced and specialized analytical instruments: Stoe STADI P Dual Transmission X-Ray Diffractometer; Xenocs Xeuss 3.0 GI-WAXS/SAXS/USAXS/Imaging System; Sigray QuantumLeap H2000 X-Ray Absorption Spectroscopy System:
    - Performing **instrument calibration, diagnostics, troubleshooting, and repair** for complex X-ray systems, including X-ray sources, detectors, furnaces, environmental stages, cooling systems, and software interfaces.

- Designing and configuring **advanced experimental setups,** such as *in situ* and *operando* measurements (high-temperature, humidity-controlled, tensile, grazing-incidence, and coin-cell experiments).
- Developing and optimizing **measurement protocols** for XRD, PDF, WAXS/SAXS/USAXS, GI-WAXS/SAXS, XANES, and EXAFS experiments.
- Conducting **high-level data reduction, analysis, modeling, and interpretation**, including Rietveld refinement, pair distribution function analysis, absolute intensity calibration, background and fluorescence correction, and synchrotron-comparative analysis.
- Providing **expert consultation** to faculty, postdoctoral researchers, graduate students, and external collaborators on experimental design, feasibility, and data interpretation.
- Training and supervising dozens of users annually on safe and effective operation of highly specialized instrumentation.
- Supporting **federally funded research**, including the U.S. National Science Foundation-Major Research Instrumentation award, by maintaining instrument readiness, preparing annual award status reports, and ensuring data quality for publications and dissertations.
- Contributing intellectually to research outcomes, resulting in **numerous peer-reviewed publications, dissertations/theses, and co-authored manuscripts** (five representative high-impact research outcomes):
    - Revealed mechanisms of arsenic adsorption onto amorphous metal (hydr)oxides affecting the material's performance.
    - Understood one-pot synthesis of monodisperse octahedral PtCu@PtM (M = Co, Ni, Fe) core–shell nanocrystals with tunable structure that exhibit exceptional ORR activity due to optimized {111} facets and metal–metal bond lengths, offering a versatile platform for advanced multimetallic electrocatalysts.
    - Understood processing-induced changes in β-sheet content and bioavailability of silk-ICG films significantly influencing immune activation and early wound healing outcomes, highlighting the potential to tailor silk scaffold structure to modulate tissue repair responses.
    - Revealed ionic crosslinked interpenetrating polymer networks forming tunable mechanical properties and preserving structural fidelity for 3D printing olefinic elastomers using photocurable K-sEPDM latexes.
    - Understood interfacial effects during melting and crystallization of zwitterionic polymers significantly tuning static permittivity with broad implications for enhancing dielectric properties in soft materials.

Postdoctoral Research Associate July 2021 – July 2023

Chemical Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN

- Responsible for federally funded research, including Thrust II of the U.S. Department of Energy-Basic Energy Sciences-Geosciences award: Understanding fluid-rock/mineral interactions and chemomechanics in geochemical systems:

- Understood the ionic effect on mineral particle aggregation and compaction through combined *in situ* (U)SANS and rare event simulations.
- Understood the chemomechanical origins of mechanical properties evolution in carbonates and novaculites due to dry and wet annealing through impulse excitation, (U)SAXS/(U)SANS, X-ray diffraction/tomography, and SEM/TEM.
- Investigated the structure of synthetic rocks created by the piston cylinder through (U)SAXS and SEM.
- Investigated stress and strain distributions induced by salt precipitation in carbonates through impulse excitation, (U)SAXS/(U)SANS, neutron/X-ray diffraction/tomography, Bragg-edge imaging, BCDI, FF-HEDM, optical flats, and μCMD simulations.

Research Associate May 2019 – July 2021

Department of Energy and Mineral Engineering, Pennsylvania State University, State College, PA

- Responsible for federally funded research, including two National Institute for Occupational Safety and Health awards: Understanding coal mine roof stability and coal nano dusts and their effects on miners' pneumoconiosis and lung cancer, and continuously focusing on fluid-rock interactions in unconventional reservoirs (coalbed methane and shale gas):
    - Revealed particle size effects on the chemical and physical properties of coal dusts and related health concerns by using combined experimental techniques (proximate/ultimate analyses, XRD, XPS, laser diffraction, and LPNA) and molecular dynamics simulations.
    - Revealed anisotropic coal pore evolution under uniaxial compression by *in situ* SANS experiment.
    - Understood confined gas (methane, CO_2, H_2O) storage and transport behaviors, pore structure, and gas confinement in shale and kerogen.

Research Assistant April 2014 – December 2018

Department of Energy and Mineral Engineering, Pennsylvania State University, State College, PA

- Responsible for federally funded research, including the U.S. National Science Foundation-Division of Chemical, Bioengineering, Environmental and Transport Systems award: Characterization and modeling of multimechanistic flow behaviors in unconventional reservoir rocks; and the U.S. Department of Energy-National Energy Technology Laboratory-Gasification System award: Understanding microbially-enhanced methane production from coal:
    - Understood mechanisms of bioconversion-induced pore structure alteration in coal with the help of combined SAXS, LPGA, and high-pressure methane adsorption methods.
    - Understood pore accessibility, gas density in pores, and pore evolution under sorptive and noble gas injection in coal and shale.

Visiting Scholar August 2017 – March 2018

Neutron Scattering Division, Oak Ridge National Laboratory, Oak Ridge, TN

- Responsible for theoretical and technical leadership, beamline operation, and sample environments of the CG-2 General-Purpose Small-Angle Neutron Scattering Diffractometer in the High Flux Isotope Reactor at Oak Ridge National Laboratory:
    - Understood ion adsorption in conductive MOF nanopores through *in operando* SANS.
    - Revealed mechanisms of temperature-dependent CO_2 capture in polyethylenimine-functionalized mesoporous silica through *in situ* high-pressure SANS.

PUBLICATIONS

Google Scholar: https://scholar.google.com/citations?user=nJJ8gfsAAAAJ&hl=en

1. **Rui Zhang**, Nikhil Rampal, Sai Adapa, Paul A. Bosomworth, Jan Ilavsky, Alexis Flores-Betancourt, Elliot Paul Gilbert, Jitendra Mata, Ercan Cakmak, Lawrence F. Allard, Markus Bleuel, Kenneth C. Littrell, Stephan Irle, Andrew G. Stack, and Lawrence M. Anovitz, "Nanoscale reprecipitation/dissolution-driven microstructural origins of chemomechanical changes in novaculite" manuscript in preparation.
2. **Rui Zhang**, Michael C. Cheshire, Markus Bleuel, David F. R. Mildner, Cedric Gagnon, and Lawrence M. Anovitz, "On the effects of solution composition on mineral particle compaction: A centrifugation, small-angle scattering study" manuscript in preparation.
3. Weiwei Li, Cheng Hu, Tianle Zhu, Yayun Chen, **Rui Zhang**, Puneet S. Dhatt, Jinghao Li, Sisi Xiang, Mengqiao Liu, Chengcheng J. Fei, Susie Y. Dai, Joshua S. Yuan "Transforming renewable carbon fiber performance, economics, and sustainability via oriented crystallization design" *Matter*: manuscript in submission.
4. Can Li, Xiaobo Chen, **Rui Zhang**, Anthony J. Woolson, Di Zhang, Shaojie Jiang, Ming Zhou, Jinfong Pan, Joseph Delgado, Anna Dennett, Prabhu Bharathan, Shaohui Yan, Aiping Chen, Guangwen Zhou, Hongwu Xu, and Jiye Fang, "Facial synthesis of ternary PtCu-based core@shell nano-octahedra with controlled {111} facets for superior oxygen reduction reaction catalysis" *Nature Synthesis*: manuscript under review.
5. Jared A. Nettles, Garvit Nayyar, **Rui Zhang**, Kailong Jin, and Timothy E. Long, "Influence of covalent network structure on the vat photopolymerization of poly(styrene-b-isoprene-b-styrene) (ABA) latex interpenetrating networks" *Industrial & Engineering Chemistry Research*: manuscript accepted.
6. Bradley Grim, Frederick L. Beyer, Kirt A. Page, **Rui Zhang**, and Matthew D. Green, "Augmenting polyzwitterion permittivity via block polymer self-assembly" *Macromolecules*: revision under review.
7. Gayathri Yogaganeshan, **Rui Zhang**, Golnaz Najaf Tomaraei, Raimund Fromme, Sharang Sharang, Jamie Ford, Douglas M. Yates, Marlene Velazco Medel, Martin Uher, Michele Zacks, Justin Flory, Jennifer Wade, and Petra Fromme, "Comprehensive structural characterization of charged polymers involved in moisture-driven direct air capture" *Materials Today Chemistry*: manuscript accepted. https://arxiv.org/abs/2508.11809
8. Ke Yuan, Juliane Weber, Nikhil Rampal, Zhengwu Fang, Jiahui You, Matthew G. Boebinger, **Rui Zhang**, Wonsuk Cha, Lawrence M. Anovitz, Sang Soo Lee, Ana Suzana, Paul Fenter, and Andrew G. Stack, "Mechanistic insights into defect-mediated crystallization revealed by lattice strain evolution" *Journal of the American Chemical Society* (2026): in print. https://pubs.acs.org/doi/full/10.1021/jacs.5c11233
9. Juliane Weber, Carolyn G. Cooke, Vitalii Starchenko, Mark Rivers, Jan Ilavsky, **Rui Zhang**, Michael J. Zachmann, Elliot P. Gilbert, Jitendra Mata, Andrew G. Stack, and Lawrence M. Anovitz, "Reaction-induced fracturing of porous carbonate rocks during volume-increasing replacement by witherite" *Crystal Growth & Design* 25(16) (2025): 6604-6619. https://pubs.acs.org/doi/full/10.1021/acs.cgd.5c00522

10. Shubham Pallod, Weston DeCambra, Trishita Chowdhury, Eron Ristich, Brian Cherry, **Rui Zhang**, David Arturo Ruiz Pardo, Juliane Daggett-Vondras, Jordan R. Yaron, Jeffery L. Yarger, and Kaushal Rege, "Modulation of secondary structure, bioavailability, immunomodulation, and tissue repair outcomes using differential processing of silk biomaterials" *ACS Biomaterials Science & Engineering* 11(8) (2025): 4881-4897. https://pubs.acs.org/doi/full/10.1021/acsbiomaterials.4c02122
11. Xinxin He, **Rui Zhang**, Derek Elsworth, and Shimin Liu, "Beyond liquid density assumption: A novel SANS-based approach to quantify adsorbed methane in coal micropores" *Chemical Engineering Journal* (2025): 164725. **as Corresponding Author**. https://www.sciencedirect.com/science/article/pii/S1385894725055615
12. Charlotte M. Barker, Timothy P. Chase, **Rui Zhang**, and Timothy E. Long, "Short chain branched polyethylene polyester segmented copolymers" *Polymer* (2025): 128572. https://www.sciencedirect.com/science/article/pii/S0032386125005580
13. Alireza Farsad, **Rui Zhang**, Chung-Seop Lee, Baile Wu, Kiril Hristovski, and Paul Westerhoff, "Modulating the central metal redox-state ratios of amorphous titanium (hydr)oxide by incorporating cerium enhances mixtures of oxyanions removal from water" *Environmental Science & Technology* 59(21) (2025): 10672-10685. https://pubs.acs.org/doi/full/10.1021/acs.est.5c02832
14. Paul A. Bosomworth, **Rui Zhang**, and Lawrence M. Anovitz, "Improved calculation of the Young's modulus of rectangular prisms from their resonant frequency overtones by identifying appropriate shear constants" *Journal of the Testing and Evaluation* 53(3) (2025): 529-546. https://dl.astm.org/jte/article/53/3/529/28768/Improved-Calculation-of-the-Young-s-Modulus-of
15. **Rui Zhang**, Paul A. Bosomworth, Juliane Weber, Jan Ilavsky, Si Athena Chen, Alexis Flores-Betancourt, Elliot Paul Gilbert, Jitendra Mata, Mark L. Rivers, Peter J. Eng, and Lawrence M. Anovitz, "The role of annealing and grain boundary controls on the mechanical properties of limestones and marbles" *International Journal of Rock Mechanics and Mining Sciences* 183 (2024): 105926. https://www.sciencedirect.com/science/article/pii/S1365160924002910
16. Jianheng Wen, Garvit Nayyar, Erin R. Crater, Ren H. Bean, **Rui Zhang**, Robert B. Moore, and Timothy E. Long, "Vat photopolymerization of olefinic elastomers from sulfonated ethylene-propylene-diene monomer (EPDM) latexes" *Additive Manufacturing* 91 (2024): 104359. https://www.sciencedirect.com/science/article/pii/S2214860424004056
17. Jose I. Sintas, Ren H. Bean, **Rui Zhang**, and Timothy E. Long, "Non-isocyanate polyurethane segmented copolymers from bis-carbonylimidazolides" *Macromolecular Rapid Communications* 45(11) (2024): 2400057. https://onlinelibrary.wiley.com/doi/full/10.1002/marc.202400057
18. Carsen Cartledge, Saivineeth Penukula, Antonella Guiri, Kayshavi Bakshi, Muneeza Ahmad, Mason Mahaffey, Muzhi Li, **Rui Zhang**, Aurora Rizzo, and Nicholas Rolston, "Scalable and quench-free processing of metal halide perovskites in ambient conditions" *Energies* 17(6) (2024): 1455. https://www.mdpi.com/1996-1073/17/6/1455
19. Paul A. Bosomworth, **Rui Zhang**, and Lawrence M. Anovitz, "Improved calculation of the shear modulus of rectangular prisms from their resonant frequency overtones" *Journal of the Testing and Evaluation* 52(2) (2024): 963-976. https://dl.astm.org/jte/article/52/2/963/22550
20. Ang Liu, Shimin Liu, **Rui Zhang**, Guijie Sang, and Kaiwen Xia, "Cyclical water vapor sorption-induced structural alterations of mine roof shale" *International Journal of Coal Geology* (2023): 104267. https://www.sciencedirect.com/science/article/pii/S016651622300085X
21. Juliane Weber, Vitalii Starchenko, Jan Ilavsky, Lawrence F. Allard, Jitendra Mata, Lisa Debeer-Schmitt, Carolyn Grace Cooke, Ken Littrell, Lilin He, **Rui Zhang**, Andrew G. Stack, and Lawrence M. Anovitz,

"Grain boundary widening controls siderite ($FeCO_3$) replacement of limestone ($CaCO_3$)" *Scientific Reports* 13(1) (2023): 4581. https://www.nature.com/articles/s41598-023-30757-y

22. **Rui Zhang**, Shimin Liu, Long Fan, Tomasz P. Blach, and Guijie Sang, "Unraveling high-pressure gas storage mechanisms in shale nanopores through SANS" *Environmental Science: Nano* 8(9) (2021): 2706-2717. https://pubs.rsc.org/en/content/articlehtml/2021/en/d1en00419k
23. Yu Liu, Shimin Liu, **Rui Zhang**, and Yu Zhang, "The molecular model of Marcellus shale kerogen: Experimental characterization and structure reconstruction" *International Journal of Coal Geology* 246 (2021): 103833. https://www.sciencedirect.com/science/article/pii/S0166516221001609
24. Shimin Liu, Weimin Cheng, Gang Wang, Long Fan, and **Rui Zhang**, "Special issue on mine dust research: Health effect and control technologies", *International Journal of Coal Science & Technology* 8(2) (2021): 177-178. https://link.springer.com/article/10.1007/s40789-021-00434-4
25. **Rui Zhang** and Shimin Liu, "Investigating hierarchical gas confinement in high-rank coal through small-angle neutron scattering" Invited paper for *Energy & Fuel* 35(16) (2021): 13109–13123. https://pubs.acs.org/doi/full/10.1021/acs.energyfuels.1c01693
26. **Rui Zhang**, Shimin Liu, and Siyang Zheng, "Characterization of nano-to-micron sized respirable coal dust: Particle surface alteration and the health impact" *Journal of Hazardous Materials* 413 (2021): 125447. https://www.sciencedirect.com/science/article/pii/S0304389421004106
27. **Rui Zhang**, Shimin Liu, Alfonso San-Miguel, Ralf Schweins, Sylvie Le Floch, and Vittoria Pischedda, "Nanoscale coal deformation and alteration of porosity and pore orientation under uniaxial compression: An *in situ* SANS study" Invited paper for a special issue of *Rock Mechanics and Rock Engineering* (2021): 1-16. https://link.springer.com/article/10.1007/s00603-020-02321-x
28. Yang Wang, Caifang Wu, Yong Qin, Shimin Liu, and **Rui Zhang**, "Multi-angle investigation of the fractal characteristics of nanoscale pores in the Lower Cambrian Niutitang shale and their implications for CH_4 adsorption" *Journal of Nanoscience and Nanotechnology* 21(1) (2021): 156-167. https://www.ingentaconnect.com/contentone/asp/jnn/2021/00000021/00000001/art00012
29. Guijie Sang, Shimin Liu, Derek Elsworth, **Rui Zhang**, and Markus Bleuel, "Pore-scale water vapor condensation behaviors in shales: An experimental study" *Transport in Porous Media* 135(3) (2020): 713-734. https://link.springer.com/article/10.1007/s11242-020-01497-8
30. Lilin He, Luming Yang, Mircea Dinca, **Rui Zhang**, and Jianlin Li, "Observation of ion electrosorption in metal-organic framework micropores with *in operando* small-angle neutron scattering" *Angewandte Chemie* 132(24) (2020): 9860-9866. https://onlinelibrary.wiley.com/doi/full/10.1002/anie.201916201
31. **Rui Zhang**, Shimin Liu, Lilin He, Tomasz P. Blach, and Yi Wang, "Characterizing anisotropic pore structure and its impact on gas storage and transport in coalbed methane and shale gas reservoirs" *Energy & Fuels* 34(3) (2020): 3161-3172. https://pubs.acs.org/doi/full/10.1021/acs.energyfuels.0c00109
32. Shimin Liu and **Rui Zhang**, "Anisotropic pore structure of shale and gas injection-induced nanopore alteration: A small-angle neutron scattering study" *International Journal of Coal Geology* 219 (2020): 103384. **as Corresponding Author**. https://www.sciencedirect.com/science/article/pii/S0166516219306652
33. Yang Wang, Yanming Zhu, **Rui Zhang**, Lawrence M. Anovitz, Markus Bleuel, Shimin Liu, and Shangbin Chen, "SANS coupled with fluid invasion approaches for characterization of overall nanopore structure and mesopore connectivity of organic-rich marine shales in China" *International Journal of Coal Geology* 217 (2020): 103343. **as Corresponding Author**. https://www.sciencedirect.com/science/article/pii/S0166516219307359

34. **Rui Zhang**, Xiaoxing Wang, Shimin Liu, Lilin He, Chunshan Song, Xiao Jiang, and Tomasz P. Blach, "Discovering inherent characteristics of polyethylenimine-functionalized porous materials for CO_2 capture" *ACS Applied Materials & Interfaces* 11(40) (2019): 36515-36524. https://pubs.acs.org/doi/full/10.1021/acsami.9b08496
35. Yang Wang, Yong Qin, Liu Yang, Shimin Liu, Derek Elsworth, and **Rui Zhang**, "Organic geochemical and petrographic characteristics of the coal measure source rocks of Pinghu Formation in the Xihu Sag of the East China Sea Shelf Basin: Implications for coal measure gas potential" *Acta Geologica Sinica* (2019). https://onlinelibrary.wiley.com/doi/full/10.1111/1755-6724.14303
36. Shimin Liu, **Rui Zhang**, Zuleima Karpyn, Hongkyu Yoon, and Thomas Dewers, "Investigation of accessible pore structure evolution under pressurization and adsorption for coal and shale using small-angle neutron scattering" *Energy & Fuel* 33 (2019): 837-847. **as Corresponding Author**. https://pubs.acs.org/doi/full/10.1021/acs.energyfuels.8b03672
37. Hao Xu, Wen Zhou, **Rui Zhang**, Shimin Liu, and Qiumei Zhou, "Characterizations of pore, mineral and petrographic properties of marine shale using multiple techniques and their implications on gas storage capability for Sichuan Longmaxi gas shale field in China" *Fuel* 241 (2019): 360-371. https://www.sciencedirect.com/science/article/pii/S0016236118320878
38. **Rui Zhang** and Shimin Liu, "Nanoscale coal deformation and its geomechanics effect on pore structure evolution under hydrostatic and uniaxial compression conditions" *53rd U.S. Rock Mechanics/ Geomechanics Symposium. American Rock Mechanics Association* (2019). https://onepetro.org/ARMAUSRMS/proceedings-abstract/ARMA19/All-ARMA19/124762
39. Yang Wang, Yong Qin, **Rui Zhang**, Lilin He, Lawrence M. Anovitz, Markus Bleuel, David F. R. Mildner, Shimin Liu, and Yanming Zhu, "Evaluation of nanoscale accessible pore structure for improved prediction of gas production potential in Chinese marine shales" *Energy & Fuel* 32 (2018): 12447-12461. **as Corresponding Author**. https://pubs.acs.org/doi/full/10.1021/acs.energyfuels.8b03437
40. Guijie Sang, Shimin Liu, **Rui Zhang**, Derek Elsworth, and Lilin He, "Nanopore characterization of mine roof shales by SANS, nitrogen adsorption, and mercury intrusion: Impact on water adsorption/retention behavior" *International Journal of Coal Geology* 200 (2018): 173-185. https://www.sciencedirect.com/science/article/pii/S0166516218306426
41. Yang Wang, Caifang Wu, Yanming Zhu, Shangbin Chen, Shimin Liu, and **Rui Zhang**, "Morphology and fractal characterization of multiscale pore structures for organic-rich lacustrine shale reservoirs" *Fractals* 26(2) (2018): 1840013. https://www.worldscientific.com/doi/abs/10.1142/S0218348X18400133
42. Guijie Sang, Shimin Liu, **Rui Zhang**, and Derek Elsworth, "Pore characterization of mine shales by low pressure nitrogen adsorption and mercury intrusion porosimetry: Implication on water retention behavior of shales" *52nd U.S. Rock Mechanics/Geomechanics Symposium. American Rock Mechanics Association* (2018). https://onepetro.org/ARMAUSRMS/proceedings-abstract/ARMA18/ARMA18/122438
43. **Rui Zhang**, Shimin Liu, and Yang Wang, "Fractal evolution under *in situ* pressure and sorption conditions for coal and shale" *Scientific Reports* 7 (2017): 8971. https://www.nature.com/articles/s41598-017-09324-9
44. **Rui Zhang**, Shimin Liu, Jitendra Bahadur, Derek Elsworth, Yi Wang, Guanglong Hu, and Yanna Liang, "Changes in pore structure of coal caused by coal-to-gas bioconversion" *Scientific Reports* 7 (2017): 3840. https://www.nature.com/articles/s41598-017-04110-z
45. **Rui Zhang** and Shimin Liu, "Experimental and theoretical characterization of methane and CO_2 sorption hysteresis in coals based on Langmuir desorption" *International Journal of Coal Geology* 171 (2017): 49-60. https://www.sciencedirect.com/science/article/pii/S0166516216308667

46. Yang Wang, Yanming Zhu, Shimin Liu, Shangbin Chen, and **Rui Zhang**, "Comparative study of nanoscale pore structure of Lower Paleozoic marine shales in the Middle-Upper Yangtze area, China: Implications for gas production potential" *Geological Journal* (2017): 1-14. https://onlinelibrary.wiley.com/doi/full/10.1002/gj.3075
47. Yang Wang, Yanming Zhu, Shimin Liu, and **Rui Zhang**, "Pore characterization and its impact on methane adsorption capacity for organic-rich marine shales" *Fuel* 181 (2016): 227-237. https://www.sciencedirect.com/science/article/pii/S0016236116302472
48. Yang Wang, Yanming Zhu, Shimin Liu, and **Rui Zhang**, "Methane adsorption measurements and modeling for organic-rich marine shale samples" *Fuel* 172 (2016): 301-309. https://www.sciencedirect.com/science/article/pii/S001623611501340X
49. **Rui Zhang**, Shimin Liu, Jitendra Bahadur, Derek Elsworth, Yuri Melnichenko, Lilin He, and Yi Wang, "Estimation and modeling of coal pore accessibility using small angle neutron scattering" *Fuel* 161 (2015): 323-332. https://www.sciencedirect.com/science/article/pii/S0016236115008820

PRESENTATIONS

1. "The effects of solution composition on mineral particle compaction: A centrifugation, small-angle scattering study" Poster presentation at *AGU Fall Meeting 2024*, Washington, D.C. December 12, 2024.
2. "X-ray scattering in materials science research" at the *2024 Penn State Climate Consortium*, State College, PA. May 13-14, 2024. **Invited two talks.**
3. "Understanding microstructural origins of chemomechanical changes in novaculite" Poster presentation at *AGU Fall Meeting 2023*, San Francisco, CA. December 14, 2023.
4. "Effect of dry and wet annealing on the mechanical properties of limestones" Poster presentation at *AGU Fall Meeting* 2022, Chicago, IL. December 16, 2022.
5. "Effect of dry annealing on the mechanical properties of limestones" Poster presentation at *Goldschmidt* 2022, Honolulu, HI. July 11, 2022.
6. "Investigating effects of salt concentration and external force on compaction of mineral nanoparticles" Oral presentation at *ACS Spring* 2022, March 21, 2022 (virtual).
7. "Investigation of high-pressure gas storage behaviors in geomaterials through SANS" in *New Chemistry Driven by Extremes Workshop, Joint Nanoscience and Neutron Scattering User Meeting*, August 4, 2021 (virtual). **Invited talk.**
8. "Scientific advancements with potential SNS STS – geoscience applications" soft matter breakout session of *New Science Opportunities with Small and Wide-Angle Neutron Diffractometer/Spectrometer at Second Target Station at SNS/ORNL Workshop*, online. February 26, 2021. **Invited talk. Contributed to the selection of CENTAUR, a small-/wide-angle scattering instrument at the Second Target Station of Oak Ridge National Laboratory.**
9. "Investigation of kerogen structures through simulation and scattering approaches" Oral presentation at *the 10th American Conference on Neutron Scattering*, July 15, 2020 (virtual).
10. "Alteration of shale anisotropic pores under uniaxial compression condition: An investigation using small-angle neutron scattering" Poster presentation at *AGU Fall Meeting 2019*, San Francisco, CA. December 11, 2019.
11. "Anisotropic pore structure of Marcellus shale under uniaxial compression: A small-angle neutron scattering study" Oral presentation at *2019 AAPG Eastern Section Annual Meeting*, Columbus, OH. October 14, 2019.

12. “Characterization of anisotropic nanopore structure of organic-rich marine shales in China: A SANS study” Oral presentation at *2019 ACA Annual Meeting*, Covington, KY. July 21, 2019.
13. “Nanoscale coal deformation and its geomechanics effect on pore structure evolution under hydrostatic and uniaxial compression conditions” Oral presentation at *the 53rd U.S. Rock Mechanics/Geomechanics Symposium. American Rock Mechanics Association*, New York City, NY. June 26, 2019.
14. “Gas densification and adsorption in rock nanopores” Oral presentation at *International Small-Angle Scattering Conference*, Treasure City, MI. October 11, 2018.
15. “Investigation of shale matrix heterogeneity, anisotropy, and strain using X-ray and in-situ neutron diffraction” Poster presentation at *Goldschmidt 2018*, Boston, MA. August 16, 2018.
16. “Observation of anisotropic nanoscale accessible pore structure for anthracite and shale using small-angle neutron scattering” Oral presentation at *the 9th American Conference on Neutron Scattering*, College Park, MD. June 25, 2018.
17. “Nanoscale accessible pore structure characterization for improved prediction of gas production potential in organic-rich shales” Poster presentation at *Marcellus Shale Coalition Meeting*, University Park, PA. April 11, 2018.

AWARDED BEAM TIME

1. “Investigating hydrogen diffusion for geological storage by quasielastic neutron scattering” *ORNL* 2025, **as Principal Investigator**.
2. “Probing hydrogen sorption and condensation in coal using small-angle neutron scattering” *ORNL* 2025.
3. “Chemomechanical feedback by salt crystallization” *CHESS* 2023, **as Principal Investigator**.
4. “Synthetic rock: A controlled, cemented, and polycrystalline material” *ORNL* and *ANSTO* 2023, **as Principal Investigator**.
5. “Salt crystallization in limestone: Effect of porosity and grain boundary” *ANSTO* 2023, **as Principal Investigator**.
6. “Microstructural origins of chemomechanical changes in rocks” *ANSTO* 2023, **as Principal Investigator**.
7. “*In situ* investigation of structural alterations induced by local humidity gradient for nanoporous shale matrix” *ORNL* 2022.
8. “Correlating strain and chemical distribution in minerals during growth and metal incorporation reactions” *ANL* 2022.
9. “*In situ* observation of porosity changes during replacement reactions via X-ray computed tomography” *ANL* 2022.
10. “Effect of pre-existing microstructure on replacement reactions rate – limestone replacement by siderite” *ORNL* 2022.
11. “Influence of pre-existing microstructure on replacement reactions – limestone replacement by siderite and witherite” *ORNL* 2021.
12. “Multication Kirkwood aggregation in Hanford wastes” *ORNL* 2021 and 2022.
13. “Grain boundary character distribution” *CHESS* 2021.
14. “Influence of the grain boundary character distribution on mineral replacement speed” *ANL* 2021.

15. “Fundamental interactions of polymer systems at small length scales: USANS/SANS studies of polymers in high-pressure hydrogen” *ORNL* 2021.
16. “Fundamental interactions of hydrogen in polymer systems at small length scales” *ORNL* 2021.
17. “Linking azimuthal fractures and pores to anisotropic gas storage and transport in shale matrix under triaxial strain condition using neutron and X-ray tomography” *NIST* 2020, **as Principal Investigator** (accepted but postponed due to pandemic and NCNR shutdown).
18. “vSANS study of shaly caprock/brine/CO_2 interaction and induced alteration of pore structure and accessibility under reservoir conditions” *NIST* 2019.
19. “Geochemical interaction of shale/water/CO_2 under *in situ* reservoir pressures using synchrotron powder diffraction” *ANL* 2019.
20. “An *in situ* PDF analysis of shale kerogen local structure alteration under methane injection” *ANL* 2019, **as Principal Investigator**.
21. “Estimation of methane diffusivity in shale nanopores using quasi-elastic neutron scattering” *NIST* 2019, **as Principal Investigator**.
22. “Gas adsorption and diffusion in shale under *in situ* conditions using VSANS and QENS” *NIST* 2018, **as Principal Investigator**.
23. “Water vapor adsorption and sorption-induced pore structure alteration of shale using SANS and USANS” *NIST* 2018, **as Principal Investigator**.
24. “Investigation of phase behavior of H_2O in shale using neutron vibrational spectroscopy” *ORNL* 2018, **as Principal Investigator**.
25. “Characterization of nanopore structure of coal mine shale using SANS” *ORNL* 2018, **as Principal Investigator**.
26. “Probing water-absorption-induced microstructure alterations of coal and shale through combined SANS and USANS” *NIST* 2017, **as Principal Investigator**.
27. “Investigation of electrochemical adsorption in porous MOF electrodes” *ORNL* 2017.
28. “*In operando* SANS study on ion adsorption in conductive porous MOF electrodes” *ORNL* 2017.
29. “SANS study on ion adsorption in conductive porous MOF electrodes” *ORNL* 2017.
30. “Probing the microstructure and adsorption behavior alterations with temperature variation for coal and shale through combined SANS and USANS” *ORNL* 2017, **as Principal Investigator**.
31. “Gypsum dehydration: The interplay between nanoporosity formation, dehydration, and phase transformation” *ORNL* 2017.
32. “An *in situ* study of temperature-dependent gas diffusion rate for coal and shale” *ILL* 2017, **as Principal Investigator**.
33. “An *in situ* study of anisotropic pore structure evolution under uniaxial stress for coal and shale” *ILL* 2017, **as Principal Investigator**.
34. “USANS feasibility studies on coal and shale samples” *NIST* 2016.
35. “Characterization of anisotropic microstructure of sorptive geomaterials using SANS” *ORNL* 2015.
36. “Understanding and modeling flow behavior in microscale pores of coal and shale rocks using SANS/USANS” *ORNL* 2014.

PROFESSIONAL ACTIVITIES

1. Co-organizer of a session entitled “Advances in multi-scale petrophysical characterizations and fluid physics in rocks and fine-grained geomaterials” in *AGU Fall 2024*. Washington, D.C. December 9-13, 2024.
2. Co-organizer of a session entitled “Frontiers in multi-scale and multi-approach characterization of fine-grained geo-materials” in *AGU Fall 2023*. San Francisco, CA. December 11-15, 2023.
3. Editorial board of the section “Geo-Energy” of *Energies* 2022-2025.
4. Co-organizer of a session entitled “Multi-scale geochemical approaches in CO_2 capture, conversion, and sequestration” in *ACS Fall 2022*. Chicago, IL. August 21-25, 2022.
5. Co-chair of a session entitled “Morphological characterization of porous materials” in the *2019 ACA Annual Meeting*, Covington, KY. July 21, 2019.
6. Co-chair of a session entitled “Coal, CBM, and gas hydrate geomechanics” in the *53rd U.S. Rock Mechanics/Geomechanics Symposium. American Rock Mechanics Association*, New York City, NY. June 24, 2019.
7. Peer reviewer of journals including *Chemical Engineering Journal, Environmental Science & Technology, International Journal of Coal Geology, Scientific Reports, Fuel, Energy & Fuels, Journal of Petroleum Science and Engineering, ACS Omega, Minerals, Energies, Water, Geofluids, Review of Scientific Instruments, etc*.
8. Peer reviewer of conference abstracts and papers of the *53rd U.S. Rock Mechanics/Geomechanics Symposium. American Rock Mechanics Association*.
9. Peer reviewer of beamtime proposals of *CG-2 GP-SANS at HFIR/ORNL* in 2021.

SKILLS

1. Expertise in using ultra-/small-/wide-angle X-ray and neutron scattering for *in situ* and *ex situ* characterizing fluid-rock and fluid-mineral interactions in geochemical, particular, and porous systems.
2. Expertise in using impulse excitation (resonant frequency technique) for characterizing elastic and anelastic properties of rocks; Expertise in using the piston cylinder in high-pressure/temperature rock synthesis.
3. Familiar with all-atom simulation, including classic and rare event molecular dynamics simulation using LAMMPS and Materials Studio.
4. Familiar with numerous *in situ* and *ex situ* characterization techniques including powder X-ray/neutron diffraction, X-ray absorption spectroscopy, X-ray photoelectron spectroscopy, Fourier transform infrared spectroscopy, atomic pair distribution function analysis, electron paramagnetic resonance, cryogenic-/nuclear magnetic resonance, X-ray/neutron tomography, inelastic and quasielastic neutron scattering and neutron spin-echo, low-pressure N_2/CO_2 adsorption, mercury intrusion porosimetry, scanning electron microscopy, volumetric/gravimetric adsorption/diffusion, and pulse-decay/constant-flow permeability, and uniaxial and triaxial compression.

AWARDS & HONORS

1. The Charles B. Darrow Award, Pennsylvania State University, 2017 and 2018
2. Frank J. Vastola and Ruth J. St. Clair Vastola Graduate Scholarship, Pennsylvania State University, 2018