Curriculum Vitae

Hang Deng
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RESEARCH INTERESTS

- **Objective**: my research is to advance fundamental understanding and predictive capability of the coupled chemical and physical processes, with an emphasis on mineral-fluid interactions, in fractured porous media in natural and engineered systems.
- **Methods**: my research involves the application and/or development of various imaging techniques (e.g. microtomography), geochemistry laboratory methods, Computational Fluid Dynamics simulations, and reactive transport models.
- **Impacts**: my research provides important implications for a range of practical challenges, including subsurface energy recovery and storage, waste disposal, and water management.

EDUCATION

Princeton University Princeton, New Jersey

Ph.D., Civil and Environmental Engineering June 2015

- Dissertation title: "Geochemical Alterations of Fractures and the Environmental and Policy Implications"
- Adviser: Prof. Catherine Peters

Peking University Beijing, China

B.S., School of Environmental Sciences June 2009
B.A., China Center for Economic Research June 2009

RESEARCH EXPERIENCE

Research Scientist, Lawrence Berkeley National Laboratory 2018 - present

- Investigating geochemical alteration of fractured basalt and the implications for CO_2 mineralization.
- Investigating reactive multiphase flow in fractured porous media.
- Developing upscaling approach for multi-physics codes.

Post-doctoral Fellow, Lawrence Berkeley National Laboratory 2015 - 2018

- Developed computationally efficient reactive transport models that integrate pore-scale processes for the prediction of fracture evolution driven by water-CO_2-rock interactions.
- Supervisors: Dr. Carl Steefel, Prof. Donald DePaolo

Doctoral Research, Princeton University 2009 - 2015

[1] *Method Development*

- Developed novel image processing techniques for characterization of fractured porous media.
- Developed an innovative fracture flow experimental system that couples high-pressure flow with *in situ* microtomography imaging (*as part of the* ***Postgraduate Research Program at the National Energy Technology Laboratory,*** *Morgantown, WV, summer, 2013*).

[2] *Numerical Modeling*

- Investigated the impacts of surface roughness on the hydraulic properties of geochemically altered fractures using Computational Fluid Dynamics simulations.

[3] *Experimental Studies*

- Investigated the interactions between geochemical reactions and geomechanical forces in an Eau Claire fracture using high-pressure fracture flow apparatus.
- Investigated the impacts of influent chemistry on fracture alteration in carbonate rocks using a high-pressure flow-through system coupled with *in situ* microtomography imaging.

[4] *Hydrogeological Analysis*

- Characterized the hydrogeological properties of a potential CO_2 injection site in Ottawa County, Michigan using well logs.

[5] *Economic and Policy Analysis*

- Investigated the impacts of leakage risk associated with geologic carbon storage on the deployment of Carbon Capture and Sequestration in the global energy system and its effectiveness as a carbon mitigation technology using Integrated Assessment Models (IAMs) (*for the* ***Graduate certificate in Science, Technology, and Environmental Policy, Princeton University***).

HONORS AND AWARDS

2018 Seaborg Fellow, Early Career Enrichment Program, Lawrence Berkeley National Laboratory

2013 ORISE Fellow, U.S. Department of Energy Professional Internship Appointment

2012 Science, Technology & Environmental Policy Fellowship,
Princeton Environmental Institute

2011 Selected as member of Princeton Energy and Climate Scholars

2009 Fellowship in Science and Engineering, Princeton University

2008 National Undergraduate Scholarship, the Ministry of Education, China

2007 China Educational Foundation for Undergraduate Students of Sciences (Grant #J0630531)

TEACHING EXPERIENCE

2012 **Environmental Implications of Energy Technologies,** Princeton University
Planed field trips to power plants, and coordinated group projects

2011 **Introduction to Environmental Engineering,** Princeton University
Assisted students with the course materials and graded problem sets

Held regular office hours and gave guest lectures

PEER-REVIEWED PUBLICATIONS

[16] S. Molins, D. Trebotich, B. Arora, C. Steefel, **H. Deng**, Multi-scale Model of Reactive Transport in Fractured Media: Diffusion Limitations on Rates, *Transport in Porous Media* (2019). https://doi.org/10.1007/s11242-019-01266-2.

[15] **H. Deng**, C.A. Peters, Reactive transport simulation of fracture channelization and transmissivity evolution, *Environmental Engineering Science*, 2019, 36(1), pp 90-101.

[14] **H. Deng**, S. Molins, D. Trebotich, C.I. Steefel, D.J. DePaolo, Pore-scale numerical investigation of the impacts of surface roughness: upscaling of reaction rates in rough fractures, *Geochimica et Gosmochimica Acta*, 2018, 239, pp 374-389.

[13] C. Noiriel, **H. Deng**, Evolution of planar fractures in limestone: the role of flow rate, mineral heterogeneity and local transport processes, *Chemical Geology*, 2018, 497, pp 100-114.

[12] P. N. Perera, **H. Deng**, P.J. Schuck, B. Gilbert, Diffusivity of Carbon Dioxide in Aqueous Solutions under Geologic Carbon Sequestration Conditions, *Journal of Physical Chemistry*, 2018, 122 (16), pp 4566-4572.

[11] **H. Deng**, C.I. Steefel, S. Molins, D.J. DePaolo. Fracture Evolution in Multimineral Systems: The Role of Mineral Composition, Flow Rate, and Fracture Aperture Heterogeneity. *Earth and Space Chemistry*, 2018, 22 (2), pp 112-124.

[10] **H. Deng**, M. Voltolini, S. Molins, C.I. Steefel, D.J. DePaolo, J. Ajo-Franklin, L. Yang. Alteration and Erosion of Rock Matrix Bordering a Carbonate-Rich Shale Fracture. *Environmental Science & Technology*, 2017, 51 (15), pp 8861–8868.

[9] **H. Deng**, J.M. Bielicki, M. Oppenheimer, J.P. Fitts, C.A. Peters. Leakage Risks of Geologic CO_2 Storage and the Impacts on the Global Energy System and Climate Change Mitigation. *Climatic Change*, 2017, 144 (2), pp 151-163.

[8] **H. Deng,** S. Molins, C.I. Steefel, D.J. DePaolo, M. Voltolini, L. Yang, J. Ajo-Franklin. A 2.5D Reactive Transport Model for Fracture Alteration Simulation. *Environmental Science & Technology*, 2016, 50 (14), pp 7564-7571.

[7] **H. Deng,** J.P. Fitts, C.A. Peters. Quantifying Fracture Geometry with X-ray Tomography: Technique of Iterative Local Thresholding (TILT) for 3D Image Segmentation. *Computational Geosciences*, 2016, 20(1), pp 231-244.

[6] J.M. Bielicki, M.F. Pollak, **H. Deng,** E.J. Wilson, J.P. Fitts, C.A. Peters. The Leakage Risk Monetization Model for Geologic CO_2 Storage. *Environmental Science & Technology*, 2016, 50(10), pp 4923-4931.

[5] **H. Deng,** J.P. Fitts, D. Crandall, D. McIntyre, C.A. Peters. Alterations of Fractures in Carbonate Rocks by CO_2-acidified Brines. *Environmental Science & Technology*, 2015, 49(16), pp 10226-10234.

[4] **H. Deng**, B.R. Ellis, C.A. Peters, J.P. Fitts, D. Crandall, G.S. Bromhal, Modifications of Carbonate Fracture Hydrodynamic Properties by CO_2-acidified Brine Flow. *Energy & Fuels*, 2013, 27(8), pp 4221-4231.

[3] **H. Deng**, F. Zhao, X. Zhao, Changes of Extreme Temperature Events in Three Gorges Area, China. *Environmental Earth Science*. 2012, 66(7), pp 1783-1790.

[2] H.Y. Dou, **H. Deng**, X.M. Sun, X.Y. Zhao, Short-term Temperature and Precipitation Forecast over Tibetan Plateau Using Mean Generating Function-optimal Subset Regression. *Acta Scientiarum Naturalium Universitatis Pekinensis*, 2010, 46, pp 643-648.

[1] F. Zhao, **H. Deng**, X. Zhao, Rainfall Regime in Three Gorges Area in China and the Control Factors. *International Journal of Climatology*, 2010, 30, pp 1396–1406.

CONFERENCE PROCEEDINGS

[4] J.M. Bielicki, **H. Deng**, J.P. Fitts, C.A. Peters, E.J. Wilson. Monetizing Leakage Risk with Secondary Trapping in Intervening Stratigraphic Layers. *Energy Procedia*, 2017, 114, pp 4456-4461.

[3] **H. Deng**, J.M. Bielicki, M. Oppenheimer, J.P. Fitts, C.A. Peters. Policy Implications of Monetized Leakage Risk from Geologic CO_2 Storage Reservoirs. *Energy Procedia*, 2014, 63, pp 6852-6863.

[2] **H. Deng**, J.P. Fitts, C.A. Peters, L. Li, D. Crandall, G.S. Bromhal. Experimental Study of Reactive Flow in an Eau Claire Fracture Exposed to CO_2-rich Brine. American Rock Mechanics Association, 2013, paper 13-592.

[1] J.P. Fitts, B.R. Ellis, **H. Deng**, C.A. Peters. "Geochemical Controls on Fracture Evolution in Carbon Sequestration". American Rock Mechanics Association, 2012, paper 12-549.

INVITED TALKS

[2] "Geochemical alteration of shale fractures and the bordering rock matrix", American Chemical Society National Meeting & Exposition, Orlando, FL, Mar, 2019.

[1] "Fracture Evolution in Multi-mineral Systems: the Role of Mineral Compositions, Flow Rate and Geometric Heterogeneity", 1st International Reactive Transport Workshop on "Reactive Transport for the Earth and Environmental Sciences in the 21st Century", France, Oct, 2017.

CONFERENCE PRESENTATIONS (FIRST AUTHOR ONLY)

[20] **H. Deng,** R. Bujack, S. Molins, C.I. Steefel, J. Ahrens, "Deciphering wormhole initiation and development using reactive transport modeling and morphological detection algorithms", AGU Fall Meeting, Washington D.C., 2018. *Poster.*

[19] **H. Deng,** S. Molins, C.I. Steefel, "Simulating evolution of rough fractures: from pore scale to continuum scale", International Conference on Coupled Processes in Fractured Geological Media: Observation, Modeling, and Application, Wuhan, China, 2018. *Oral.*

[18] **H. Deng,** S. Molins, C.I. Steefel, "Pore-scale reactive transport modeling of mineral-water interactions and implications for reaction rate upscaling", Computational Methods in Water Resources, Saint-Malo, France, 2018. *Oral.*

[17] **H. Deng,** C.I. Steefel, S. Molins, D.J. DePaolo, "Pore-scale simulation of CO_2-water-rock interaction: upscaling of reaction rates in a rough fracture", AGU Fall Meeting, New Orleans, LA, 2017.

[16] **H. Deng**, C.I. Steefel, S. Molins, D.J. DePaolo, "Impacts of Heterogeneities on Fracture Alteration: Investigations Using a Reduced Dimension Reactive Transport Model", Goldschmidt Conference, Paris, France, 2017. *Oral.*

[15] **H. Deng**, S. Molins, D.J. DePaolo, C.I. Steefel, D. Trebotich, "Investigation of the Influence of Surface Roughness on Geochemical Reaction Rates in Fractures", 9th International Conference on Porous Media and Annual Meeting, Rotterdam, NL, 2017. *Oral.*

[14] **H. Deng,** C.I. Steefel, S. Molins, D.J. DePaolo, "Mineralogical Control of Fracture Alteration", AGU Fall Meeting, San Francisco, CA, 2016. *Oral.*

[13] **H. Deng,** S. Molins, C.I. Steefel, D.J. DePaolo, "Simulating Fracture Alteration Caused by CO_2-water-Rock Interactions", Goldschmidt Conference, Yokohama, Japan, 2016. *Oral.*

[12] **H. Deng,** S. Molins, C.I. Steefel, D.J. DePaolo, M. Voltolini, J. Ajo-Franklin. "Simulating the Evolution of Fracture Surface Alteration Exposed to CO_2-acidified Brine", AGU Fall Meeting, San Francisco, CA, 2015. *Oral.*

[11] **H. Deng**, Jeffrey Fitts, Catherine Peters, "Geochemical Alterations of Carbonate Fractures", 250th ACS National Meeting, Boston, MA, 2015. *Oral.*

[10] **H. Deng**, J.P. Fitts, C.A. Peters, "Geochemical Alterations of Carbonate Fractures and the Environmental Implications", AEESP Research and Education Conference, New Haven, CT, 2015. *Poster.*

[9] **H. Deng**, J.M. Bielicki, M. Oppenheimer, J.P. Fitts, C.A. Peters, "How Leakage Risk in Geologic CO_2 Storage Might Impact Climate Change Mitigation and Policy Choices", AEESP Research and Education Conference, New Haven, CT, 2015. *Poster.*

[8] **H. Deng**, J.M. Bielicki, M. Oppenheimer, J.P. Fitts, C.A. Peters, "Accounting for the Leakage Risk of Geologic CO_2 Storage and Its Impacts on Climate Mitigation and the Global Energy System" The 14th Annual Carbon Capture, Utilization and Storage Conference, Pittsburgh, PA, 2015. *Oral.*

[7] **H. Deng**, J.P. Fitts, D. Crandall, D. McIntyre, C.A. Peters, "Permeability Evolution of Fractured Limestone due to Reactive Flow: Observation and Prediction of Wormhole Formation", AGU Fall Meeting, San Francisco, CA, 2014. *Poster.*

[6] **H. Deng**, J.M. Bielicki, M. Oppenheimer, J.P. Fitts, C.A. Peters, "Policy Implications of Monetized Leakage Risk from Geologic CO_2 Storage Reservoirs" International Conference on Greenhouse Gas Technologies (GHGT), Austin, TX, 2014. *Poster.*

[5] **H. Deng**, C.A. Peters, J.P. Fitts, D. Crandall, G. Bromhal, L. Li "Impacts of Reactive Fluids on Fracture Flows in the Context of Subsurface Energy Technologies". AEESP Research and Education Conference. Golden, CO, 2013. *Poster.*

[4] **H. Deng**, J.P. Fitts, R. Tappero, C.A. Peters, S. Wirick, W. Rao. "X-ray Imaging Studies of Water-Rock Interactions at Fracture Surfaces during Fluid Flow", 2013 National Synchrotron Light Source/Center for Functional Nanomaterials (NSLS/CFN) Joint Users' Meeting, Brookhaven National Lab, Upton, NY, 2013. *Poster.*

[3] **H. Deng**, B.R. Ellis, C.A. Peters, J.P. Fitts, D. Crandall, G. Bromhal "Modification of fracture hydrodynamic properties by CO_2-acidified brine flow". AIChE Annual Meeting, 2012. *Oral.*

[2] **H. Deng**, D. Crandall, S. King, B.R. Ellis, G. Bromhal, J.P. Fitts, C.A. Peters, "Change in Fracture Permeability after the Flow-through of CO_2-acidified brine", AGU Fall Meeting, San Francisco, CA, 2011. *Poster.*

[1] **H. Deng**, C.A. Peters, J.P. Fitts, M. Pollak, E. Wilson, "Hydrogeological Characterization of a Potential CO_2 Injection Site in Ottawa County, Michigan", AGU Fall Meeting, San Francisco, CA, 2010. *Poster.*

PROFESSIONAL ACTIVITIES AND MEMBERSHIP

Primary Convener:

- Session "Modeling of Reactive Transport Processes Across Scales", AGU Fall Meeting, Washington D.C., U.S.A., 2018.
- Session "Evolving porous media and coupled chemical and physical processes", InterPore 10th Annual Meeting and Jubilee, New Orleans, U.S.A., May, 2018.
- Session "Mixing and Reactive Transport Processes in Hydrological Systems Across Scales", AGU Fall Meeting, New Orleans, U.S.A., Dec, 2017.

Co-convener:

- Session "Cross-Scale Imaging and Image-Based Modeling of Subsurface Flow and Fluid–Rock Interactions in Porous and Fractured Media", AGU Fall Meeting, Washington D.C., U.S.A., 2018.
- Session "Reactive Transport in Fractures", International Conference on Coupled Processes in Fractured Geological Media: Observation, Modeling, and Application, Wuhan, China, Nov, 2018.
- Session "Pore-Scale Geochemical Processes & the Implications to CO_2 Geologic Storage", 253rd American Chemical Society National Meeting & Exposition, San Francisco, U.S.A., April, 2017.
- Session "Geochemical and Transport Processes Associated with CO_2 Geological Storage", Goldschmidt Conference, Yokohama, Japan, Aug, 2016.

Reviewer (Journals): *Applied Mathematical Modelling, Chemical Engineering Journal, Chemical Geology, Computational Geosciences, Computer Methods and Programs in Biomedicine, Earth and Space Chemistry, Environmental Science & Technology, Environmental Science & Technology Letters, Environmental Engineering Science, Geochimica et Cosmochimica Acta, Geophysical Research Letters, Greenhouse Gases: Science and Technology, Hydrology and Earth System Sciences, International Journal of Greenhouse Gas Control, Science Advances, Science of the Total Environment, Transport in Porous Media, Water Resources Research*

Member: *American Geophysical Union, American Chemical Society, European Association of Geochemistry*

COMMUNITY SERVICES

2019-	**Hydrology Section Program Committee**, American Geophysical Union Fall meeting
2018-	**Division Council**, Energy Geosciences Division, Lawrence Berkeley National Laboratory
2018-	**Membership Chair** of the Geochemistry Division, American Chemical Society
2018	**Judge** of the GEM Fellowship Program, The National GEM Consortium
2017-	**Distinguished Scientists Seminar Series Committee**, Earth and Environmental Sciences Area, Lawrence Berkeley National Laboratory
2017-2018	**Chair** of the Diversity Subcommittee, Early Career Network of the EFRC (Energy Frontier Research Center) Program

Organized a webinar on "promoting diversity and inclusion in the energy sciences", June, 2018

2016-2017 **Chair** of the Career Subcommittee, Early Career Network of the EFRC (Energy Frontier Research Center) Program

Organized the "Career Paths for Young Professional Panel Discussion" at the EFRC-Hub-CMS PI meeting, Washington, D.C., July 2017

Organized a webinar on "Grant/Proposal Writing", Aug, 2017

2016-2017 **President** of Chinese Environmental Scholars Forum

Organized the Fourth Chinese Environmental Scholars Forum, Berkeley, CA, May 20-21, 2017

2016-2017 **Board Member and Treasurer** of Berkeley Laboratory Postdoc Association

2014-2015 **President and Founding Member** of China Energy Group, Princeton University