

CURRICULUM VITAE

Chen Zhu

PERSONAL INFORMATION

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EDUCATION

Ph.D., The Johns Hopkins University, Aqueous Geochemistry, 1992
M.Sc., University of Toronto, Economic Geology/Geochemistry, 1987
B.Eng., Chengdu Institute of Geology, Geology (with honors), 1982

Post-doctoral Fellowship, Woods Hole Oceanographic Institution, 1991-92

HONORS AND AWARDS

2021-22, Henry Darcy Distinguished Lecturer, the Groundwater Foundation.
2019, Professeur Invité, Toulouse Paul-Sabatier University/CNRS, France.
2017, Fellow, American Association for the Advancement of Science.
2016, Fellow, Mineralogical Society of America.
2009, Fulbright Scholarship to Norway.
2008, Guest Professorship, Swiss Federal Institute of Technology (ETH) Zurich, Switzerland.
2006, The John Hem Excellence in Science and Engineering Award, National Ground Water Association.
2006-07, Lilly Freshman Learning Project Fellow (teaching), Indiana University.
2005, Fellow, Geological Society of America.
2004, Guest Professorship, Swiss Federal Institute of Technology (ETH) Zurich, Switzerland.
2003-04, Senior Associateship Award, National Research Council of the National Academies.
1985-87, H. V. Ellsworth Prize in Mineralogy, University of Toronto.

EMPLOYMENT

01/04-present Indiana University, Haydn Murray Chair (10/2018-6/2021), Professor (7/2011-present), Associate Professor (1/2004-7/2011)
2000-2003 Assistant Professor of Geology and Planetary Science, University of Pittsburgh
1998-2000 Assistant Professor of Ocean, Earth, and Atmospheric Sciences, Old Dominion Univ
1994-1998 Senior Geochemist, GeoTrans, Inc. (now part of TetraTech), Boulder, Colorado
1993-1994 Senior chemist, OLI Systems, Morristown, New Jersey.

RESEARCH INTERESTS

I identify and study fundamental CO₂-water-rock interaction research problems that play a critical role in society's urgent climate change mitigation and adaptation endeavors. While the core of my research is always the kinetics, thermodynamics, and geochemical modeling of water-rock interactions, my current research projects can be categorized into three climate change-related themes.

First, storing billions of tons of CO₂ in aquifers, minerals, and soils causes myriad CO₂-water-rock interactions. My geochemical kinetics research helps to predict the consequences of these interactions in terms of CO₂ storage efficiency and safety. Click this link for our CCUS [publications](#).

Second, the transition from fossil fuel to renewable energy requires critical minerals that formed as precipitates from water. Recently, my collaborators and I have started a project on the thermodynamic and transport properties of rare earth elements to better inform the successful exploration of mineral resources. An additional collaborative project assesses the potential release of toxic elements into streams from mining lithium in central Europe. The predictive power of geochemical modeling, if grounded in solid sciences, is a critical tool for promoting environmentally responsible and socially acceptable handling of wastes generated from mineral extraction.

Third, a warming climate impacts both water quantity and water quality. Studies of CO₂-water-rock interactions inform both the quantity and direction of fluid flow and the release mechanisms of contaminants to water. Recently, we have developed a regional scale hydrological model that predicts a severe reduction of water availability in the historically water-rich Wabash River basin (USA) toward the end of the century (<https://FutureWater.indiana.edu>). Currently, we are developing models to assess the impact on water quality, using high-performance computers and machine learning tools.

SYNERGIC ACTIVITIES (last five years)

Proposal review panelist, NSF, 2021-22 (graduate fellowship); NASA, 2019; NSF, 2018.

Associate Editor, *Ground Water*, a journal sponsored by the National Ground Water Association, 10/21-present; *Geochimica et Cosmochimica Acta* (official bulletin of the Geochemical Society), 2005-21.

Led a large team at IU and developed cyberplatform <https://futurewater.indiana.edu/> for research, teaching, and service, which hosts coupled surface-water and groundwater models of the Wabash River basin that covers most of Indiana.

Developed cyberplatform <https://models.earth.indiana.edu/> which hosts geochemical modeling software and thermodynamic and kinetic databases widely used by the geochemical community for research and teaching. About ~3000 users around the world accessed this resource 9/2020-11/2021.

Organized and taught (with Peng Lu) a pro bono workshop (virtual), 2-3 July 2021, “*Advanced Geochemical Modeling*” sponsored by the Geochemical Society and broadcasted from Indiana University. About 348 attendees from 44 countries participated.

Organized a pro bono workshop (virtual), 21 June 2020, “*Applications of isotope tracers to geochemical kinetics studies*” sponsored by the Geochemical Society and broadcasted from Indiana University. About 300 attendees from 34 countries participated. Lecture videos available at <https://hydrogeochem.earth.indiana.edu/>

Organized departmental colloquium series, Academic year 2019-2020

Co-convened sessions at national and international conferences (American Geophysical Union, fall 2019; Geological Society of America, 2018; co-chair, Geochemistry of Earth's Surface, 2017)

CURRENT RESEARCH GRANTS

| Begin | End | Agencies/Title/PI | Amount |
|----------|----------------|--|--|
| 7/01/19 | 6/30/22 | National Science Foundation, EAR-1926734 <i>“Testing hypothesis of near-equilibrium kinetics for silicate minerals with an innovative isotope doping method”</i> Principal Investigator: Chen Zhu | \$410,556 |
| 9/15/21 | 9/14/24 | Department of Energy, Basic Energy Sciences, DE-SC0022269 <i>“Molecular complexation of rare earth elements (REE) in high temperature and pressure supercritical geologic fluids”</i> PI: Alex Gysi; co-PI: Chen Zhu and five others | \$2,700,000 0 \$360,000 to IU |
| 9/1/17 | 8/30/22 NCE | Petroleum Research Fund, New Direction Fund <i>“Organic-inorganic interactions during hydrocarbon secondary migration: Effects on reservoir quality”</i> Principal Investigator: Chen Zhu | \$110,000 |
| 11/29/17 | 06/30/22 | Indiana University Grand Challenge Project <i>“Prepared for environmental changes: Hydro project”</i> Project lead: Chen Zhu | \$688,674 |

EXTERNAL GRANTS COMPLETED AT INDIANA UNIVERSITY

| Begin | End | Agencies/Title/PI | Amount |
|----------|---------|---|-----------|
| 9/27/12 | 9/26/16 | National Science Foundation, EAR-1225733 <i>“A New Approach to Experimental Determination of Coupled Silicate Dissolution - Precipitation Reaction Rates at Ambient Conditions with Si Isotope Spikes”</i> Principal Investigator: Chen Zhu | \$299,483 |
| 10/01/10 | 3/31/15 | Department of Energy, DE-FE0004381 <i>“Reducing Uncertainties in Model Predictions via History Matching of CO₂ Migration and Reactive Transport Modeling of CO₂ Fate at the Sleipner Project, Norwegian North Sea”</i> Principal Investigator: Chen Zhu | \$399,418 |
| 7/1/05 | 6/30/10 | National Science Foundation, EAR-0509755 <i>“Coupled silicate reaction kinetics in an aquifer”</i> Principal Investigator: Chen Zhu | \$240,000 |
| 09/1/06 | 8/31/09 | National Science Foundation, Major Research Instruments, 0619462 <i>“Acquisition of a Dual High Resolution and Cryo Transmission Electron Microscope by Indiana University”</i> Principal Investigator: Suchetana Mukhopadhyay Co-Principal Investigator: Chen Zhu Co-Principal Investigator: Yves Brun Co-Principal Investigator: Lyudmila Bronstein Co-Principal Investigator: Bogdan Dragnea | \$713,090 |
| 8/1/08 | 7/31/13 | National Science Foundation, EAR-0809903 | \$98,590 |

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| | | <i>“Collaborative Research: Microbial Arsenate Reduction Control on Arsenic in Groundwater”</i> Principal Investigator: Chen Zhu; Co-Principal Investigator: Lisa M. Pratt | |
| 4/1/09 | 7/1/09 | U.S. Department of Energy, National Energy Tech Laboratory <i>“Geochemical analysis related to carbon sequestration”</i> Principal Investigator: Chen Zhu | \$5,000 |
| 9/1/04 | 8/31/09 | U.S. Department of Energy, Office of Fossil Energy, DE-FG26-04NT42125 <i>“A novel approach to experimental studies of mineral dissolution kinetics”</i> Principal Investigator: Chen Zhu | \$426,701 |
| 4/1/08 | 7/1/08 | U.S. Department of Energy, National Energy Tech Laboratory <i>“Geochemical analysis related to carbon sequestration”</i> Principal Investigator: Chen Zhu | \$3,000 |
| 2/1/04 | 1/31/06 | Department of Energy, Office of Sciences, DE-FG02-04ER63740 <i>“High-resolution mineralogical characterization and biogeochemical modeling of uranium reaction pathways at the FRC”</i> Principal Investigator: Chen Zhu | \$99,325 |
| 9/00 | 8/05 | National Science Foundation, EAR 0423971/ EAR-0003816 <i>“Collaborative Research: Silicate reaction kinetics in a major aquifer in Arizona”</i> Principal Investigator: Chen Zhu; Co-Principal Investigator: David Veblen, Johns Hopkins University | \$142,682 |
| 1/01 | 9/05 | Institute of Geophysics and Planetary Physics (1208) <i>“Silicate reaction kinetics in a major aquifer in New Mexico”</i> Principal Investigator: Chen Zhu | \$116,058 |
| 9/1/03 | 8/31/05 | U.S. Department of Energy, Office of Fossil Energy, DE-FG26-03NT41806 <i>“Exploratory research on simulation of CO₂-H₂O-brine- mineral Interactions”</i> Principal Investigator: Chen Zhu | \$50,000 |
| 1999 | 2000 | U.S. Environmental Protection Agency, <i>“Mathematical and chemical modeling of attenuation of mine drainage”</i> PI: Chen Zhu | \$123,000 |
| 1998 | 1999 | U.S. Environmental Protection Agency <i>“EPA guidance on environmental applications of geochemical modeling”</i> PI: Chen Zhu | \$150,000 |

INTERNAL GRANTS COMPLETED AT INDIANA UNIVERSITY

| Begin | End | Agencies/Title/PI | Amount |
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|---------|---------|---|----------|
| 1/15/19 | 2/15/22 | Indiana University, Faculty Research Support Program-external resubmission "Near-equilibrium kinetics" Principal Investigator: Chen Zhu | \$45,000 |
| 2/5/20 | 8/4/21 | Eli Lilly Foundation via Indiana Univ, Center for Rural Engagement "Arsenic speciation in Indiana groundwater" Co-PI: Chen Zhu | \$49,397 |

List of Publications

[Google Scholar](#) h-index = 39 (as of December 27, 2021), orcid.org/0000-0001-5374-6787, Researcher ID: A-5356-2010

BOOKS

Zhu C and Anderson GM (2002) *Environmental Applications of Geochemical Modeling*. Cambridge University Press, London, 304 pp. [weblink](#)

Zhu C, Anderson GM, Lu P (2017) *Theories and Applications of Geochemical Modeling*. Science Publication Co., Beijing, China, ISBN 978-7-03-053048-6, 351 pp (in Chinese).

REFEREED JOURNAL PUBLICATIONS

([‡]student or post-doc authors supervised by Zhu; *corresponding author when not the first author)

In Review:

Majeske N, Zhang XS, Sabaj MM, Gong L, **Zhu C**, Azad A. Inductive Predictions of Hydrologic Events Using a Long Short-Term Memory Network and the Soil and Water Assessment Tool. *Journal of Environmental Modelling and Software*, submitted August 19, 2021

Lu P, Zhang GR, Huang Y, Apps J, and **Zhu C**. Dawsonite as a temporary but effective sink for geological carbon storage " *International Journal of Greenhouse Gas Control*. Submitted on August 21, 2021.

Published or Available Online:

[86] Toupal J, Vann DR, Zhu C, Gieré R (2022) Geochemistry of surface waters around four hard-rock lithium deposits in Central Europe. *Journal of Geochemical Exploration* v234, 106937, <https://doi.org/10.1016/j.gexplo.2021.106937>.

[85] [‡]Kang JT, Bracco JN, Rimstidt JR, Zhu GH, Huang F, ***Zhu C** (2022). Ba attachment and detachment fluxes to and from barite surfaces in ¹³⁷Ba-enriched solutions with variable [Ba²⁺]/[SO₄²⁻] ratios near solubility equilibrium. *Geochimica et Cosmochimica Acta*. v317, 180-200, doi.org/10.1016/j.gca.2021.11.008. Acknowledged Haydn Murray chair endowment.

[84] Lu P, Zhang GR, Apps J, ***Zhu C**. (2022) Comparison of thermodynamic data files for PHREEQC. *Earth-Science Reviews*, <https://doi.org/10.1016/j.earscirev.2021.103888>. Acknowledged NSF-1926734, Murray chair endowment, FRSP-ER.

- [83] Lu P, Luo P, Wei W, **Zhu C** (2022) Effects of gas saturation and reservoir heterogeneity on thermochemical sulfate reduction reaction in a dolomite reservoir, Puguang Gas Field, China. *Marine and Petroleum Geology*, v135, 105403, doi.org/10.1016/j.marpetgeo.2021.105402. Acknowledged PRF grant 57727-ND2.
- [82] Zhang GR, *Lu P, Huang Y, Li GH, ***Zhu C** (2021) Investigation of mineral trapping processes based on coherent front propagation theory: A dawsonite-rich natural CO₂ reservoir as an example. *International Journal of Greenhouse Gas Control* v110, 103400, <https://doi.org/10.1016/j.ijggc.2021.103400>.
- [81] **Zhu C**, ‡Zhang YL, Rimstidt JD, Gong L, ‡Burkhart, JA, Chen KY, Yuan HL (2021) Testing hypotheses of albite dissolution mechanisms at near-equilibrium using Si isotope tracers. *Geochimica et Cosmochimica Acta*. v303, 15-37. doi.org/10.1016/j.gca.2021.03.023. Acknowledged NSF-1926734, Murray chair endowment, FRSP-ER.
- [80] Majeske N, ‡Abesh B, **Zhu C**, Azad A. (2021) Inductive Predictions of Extreme Hydrologic Events in the Wabash River Watershed. In *Proceedings of 34th Conference on Neural Information Processing Systems (NeurIPS 2020) Vancouver, Canada*. (In this discipline, conference proceeding papers are peer-reviewed and have the same standing as journal articles). [Web link](#).
- [79] Lu P, Luo P, Zhang GR, Zhang S, ***Zhu C** (2020). A Mineral-Water-Gas Interaction Model of pCO₂ as a Function of Temperature in Sedimentary Basins. *Chemical Geology*. v.558, doi.org/10.1016/j.chemgeo.2020.119868, Acknowledged PRF grant 57727-ND2.
- [78] Zhang GR, Lu P, ‡Zhang YL, ‡Tu K, ***Zhu C** (2020) SupPHREEQC: A program to generate customized PHREEQC thermodynamic database based on Supcrtbl. *Computers & Geosciences*. v143. doi.org/10.1016/j.cageo.2020.104560. Acknowledged NSF-1926734, OVPR, Murray chair endowment, PRF grant 57727-ND2.
- [77] ‡Dierauer J, **Zhu C**, Gong L, Walsh A, Pamidighantam S, Wang J, Christie M, and Abeysinghe E (2020) FutureWater Indiana: A science gateway for spatiotemporal modeling of water in Wabash basin with a focus on climate change. In *Proceedings of CATCH THE WAVE AT PEARC20: Practice and Experience in Advanced Research Computing (PEARC '20)*. ACM, New York, NY, USA, 252-261. DOI: [10.1145/3311790.3396651](https://doi.org/10.1145/3311790.3396651). With acknowledgments to PfEC. (In this discipline, conference proceeding papers are peer-reviewed and have the same standing as journal articles).
- [76] ‡Wang JR, Liu GM, ***Zhu C** (2020) Evaluating precipitation products for hydrologic modeling over a large river basin in the Midwestern USA. *Hydrological Science Journal, Bulletin of International Association of Hydrologic Science*. v65(7), 1221-1238. [doi:10.1080/02626667.2020.1737868](https://doi.org/10.1080/02626667.2020.1737868). Acknowledged PfEC.
- [75] Barna JM, Fryar AE, Cao L, Currens BJ, Peng T, **Zhu C** (2020) Variability in Groundwater Flow and Chemistry in the Houzhai Karst Basin, Guizhou Province, China. *Environmental and Engineering Geoscience* v26(3), 273-289. <https://doi.org/10.2113/EEG-2306>.
- [74] ‡Dierauer JR, ***Zhu C**. (2020) Drought in the twenty-first century in a water-rich region: Modeling study of the Wabash River Watershed, USA. *Water*. v12(1), #181, [doi:10.3390/w12010181](https://doi.org/10.3390/w12010181). Acknowledged ERI/PfEC.
- [73] **Zhu C**, Rimstidt JD, ‡Zhang YL, ‡Kang JT, Schott J, Yuan HL (2020) Decoupling feldspar dissolution and precipitation rates at near-equilibrium with Si isotope tracers: Implications for

- modeling silicate weathering. *Geochimica et Cosmochimica Acta*. v271, 132-153. DOI: [10.1016/j.gca.2019.12.024](https://doi.org/10.1016/j.gca.2019.12.024). Acknowledged NSF-1926734, OVPR
- [72] Gong L, Rimstidt JD[‡], [‡]Zhang YL, Chen KY, ***Zhu C** (2019) Unidirectional kaolinite dissolution rates at near-equilibrium and near-neutral pH conditions. *Applied Clay Science* v182, doi.org/10.1016/j.clay.2019.105284; acknowledged NSF-1926734, OVPR
- [71] [‡]Zhang YL, Gong L, Chen KY, [‡]Burkhart J, Yuan HL, ***Zhu C** (2020) A method for Si isotope tracer kinetics experiments: Using Q-ICP-MS to obtain ²⁹Si/²⁸Si ratios in aqueous solutions. *Chemical Geology* v531, DOI: [10.1016/j.chemgeo.2019.119337](https://doi.org/10.1016/j.chemgeo.2019.119337); acknowledged NSF-1926734, OVPR
- [70] [‡]Zhang YL, [‡]Hu B, Teng YG, ***Zhu C** (2019) A library of BASIC scripts of reaction rates for geochemical modeling using PHREEQC. *Computers & Geosciences*, v133, doi.org/10.1016/j.cageo.2019.104316; acknowledged NSF-1926734, OVPR
- [69] [‡]Zhang YL, Rimstidt JD, Huang Y, ***Zhu C** (2019) Kyanite far from equilibrium dissolution rate at 0–22 °C and pH of 3.5–7.5. *Acta Geochimica* 38: 1-9. Acknowledged NSF-1225733 and IU. [Web link](#).
- [68] [‡]Hu B, Teng YG, [‡]Zhang YL, ***Zhu C** (2019) Review: The projected hydrological cycle under the scenario of 936 ppm CO₂ in 2100. *Hydrogeology Journal*, 27(1): 31-53, DOI [10.1007/s10040-018-1844-9](https://doi.org/10.1007/s10040-018-1844-9); acknowledged PfEC/ERI.
- [67] [‡]Zhang GR, Lu P, Luo P, Sonnenthal E, Huang Y, ***Zhu C** (2019) Effects of natural gas acidic components on local porosity generation in a carbonate reservoir: Insights from reactive transport modeling. *AAPG Bulletin* 103(12): 2975-3001, <https://doi.org/10.1306/04151917422> Acknowledged PRF grant 57727-ND2
- [66] Teng, YG, [‡]Hu B, Zheng J, Wang JS, Zhai YZ, **Zhu C** (2018) Water quality responses to the interaction between surface water and groundwater along the Songhua River, NE China. *Hydrogeology Journal*, 26(5): 1591-1607. <https://doi.org/10.1007/s10040-018-1738-x>
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- [3] **Zhu C** (1993) New pH sensor for hydrothermal fluids. *Geology* 21: 983-986. [Weblink](#)
- [2] **Zhu C** and Sverjensky DA (1992) F-Cl-OH partitioning between apatite and biotite. *Geochimica et Cosmochimica Acta* 56: 3435-3467. [Weblink](#)
- [1] **Zhu C** and Sverjensky DA (1991) Partitioning of F-Cl-OH between minerals and hydrothermal fluids. *Geochimica et Cosmochimica Acta* 55: 1837-1858. [Weblink](#)

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- [10] **Zhu, C**, †Zhang YL, Rimstidt JD, Yuan HL (2019) Measuring reaction rates at equilibrium with the isotope doping method. *Proceedings of the 16th International Symposium on Water-Rock Interaction WRI-16*, Tomsk, Russian, July 21-26, 2019. [10.1051/e3sconf/20199813003](https://doi.org/10.1051/e3sconf/20199813003)

- [9] Zhang G, Lu P, Ji X, **Zhu C** (2017) CO₂ plume migration and fate at Sleipner, Norway: Calibration of numerical models, uncertainty analysis, and reactive transport modelling of CO₂ trapping to 10,000 years. *Energy Procedia* 114: 2880-2895. doi: 10.1016/j.egypro.2017.03.1410.
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- [7] **Zhu, C**, †Liu Z, †Schaefer A, †Wang C, †Zhang G, Gruber C, Ganor G, Georg RB (2014) Silicon isotopes as a new method of measuring silicate mineral reaction rates at ambient temperature. *Procedia Earth and Planetary Science* 10: 189-193, doi: 10.1016/j.proeps.2014.08.055
- [6] Ji X and **Zhu C** (2013) A SAFT Equation of State for the H₂S-CO₂-H₂O-NaCl system and applications for CO₂ - H₂S transportation and geological storage. *Energy Procedia* 37: 3780-3791. doi: 10.1016/j.egypro.2013.06.274.
- [5] **Zhu C**, Lu P (2013) Coupling of dissolution and precipitation reactions as the main contributor to the apparent discrepancy between lab and field reaction rates. *Procedia of Earth and Planetary Sciences* 7: 948-952, doi: 10.1016/j.proeps.2013.03.051.
- [4] Ji X and **Zhu C** (2010) Modelling of phase equilibria in the H₂S-H₂O system with statistical associating fluid theory. *Proceedings of the 19th International Congress of Chemical and Process Engineering CHISA 2010 and the 7th European Congress of Chemical Engineering ECCE-7*, Prague, August 28 - September 1, 2010, 9 pages.
- [3] **Zhu C**, Blum AE, Veblen DR (2004) Feldspar dissolution rates and clay precipitation in the Navajo aquifer at Black Mesa, Arizona, USA. *Proceedings of the Eleventh International Symposium on Water-Rock Interaction WRI-11*, Vol. 2 (ed. R. B. Wanty and R. R. I. Seal), 27 June-2 July 2004, Saratoga Springs, New York, A.A. Balkema, pp. 895-899. [Weblink](#)
- [2] Soong Y, Allen DE, McCarthy-Jones JR, Harrison DK, Hedges SH, Baltrus JP, **Zhu C** (2004) Preliminary experimental results of CO₂ sequestration with brine. *Proceedings of the Eleventh International Symposium on Water-Rock Interaction WRI-11*, Vol. 2 (ed. R. B. Wanty and R. R. I. Seal), 27 June-2 July 2004, Saratoga Springs, New York, A.A. Balkema, pp. 597-600
- [1] **Zhu C**, Yeh G, Waddell RK (1996) A new approach to modeling metal contaminant transport associated with mining wastes, *Proceedings of Tailings & Mining Waste* 96: 341-250.

BOOK CHAPTERS

Ji X and **Zhu C** (2015) CO₂ storage in deep saline aquifers. In: Morreale B, Shi F (eds) *Novel Materials for Carbon Dioxide Mitigation Technology*, Elsevier, pp 299-332.

<http://dx.doi.org/10.1016/B978-0-444-63259-3.00010-0>

Zhu C (2012) Geochemical modeling in environmental and geological studies. In: Meyers RA (ed) *Encyclopedia of Sustainability Science and Technology*, Springer, doi: 10.1007/978-1-4419-0851-3.

Kelly S, †Lu P, Newville MG, Bolin T, Chattopadhyay S, Shibata T, **Zhu C** (2008) Molecular structure of Lead (II) coprecipitated with Iron(III) oxyhydroxide. In: Barnett M and Kent D (eds) *Adsorption of Metals by Geomedia II: Variables, Mechanisms, and Model Applications*, Elsevier, pp 67-94, doi: 10.1016/S1571-9197(07)07003-6.

BOOK REVIEWS

Zhu (2017) *Geochemical Rate Models: An Introduction to Geochemical Kinetics*. By J. Donald Rimstidt (2013) Cambridge University Press, 232 p. \$84.99 Hardback, ISBN: 9781107029972. American Mineralogist 101: 921-922

COMMENTARIES

Zhu C (2011) The globalization of Chinese geosciences: A threat or an opportunity? Elements 7(6): 367-368. [Weblink](#)

Patents

U.S. Patent 7922792 issued on 12 April 2011 “Method for Sequestration of CO₂ and SO₂ Utilizing a Plurality of Waste Streams.”

The patent describes a novel neutralization/sequestration process for concomitantly addressing the capture and sequestration of both CO₂ and SO₂ from industrial gas byproduct streams, such as bauxite residue from aluminum production and brine from oil/gas production. The possible users of this invention include the power industry for disposal of CO₂/SO₂, the gas/oil industry for disposal of brine, and the aluminum industry for disposal of bauxite residue.

Invited Talks

2021 Vanderbilt University. Department of Earth and Environmental Science, December 17, 2021, Groundwater Week, an annual national conference organized by the National Groundwater Association, Nashville, TN. December 15, 2021.

Groundwater Summit, an annual national meeting organized by the National Ground Water Association, Keynote address & Darcy lecture. December 7, 2021,

University of Michigan, Department of Earth and Environmental Science, Ann Arbor, MI. The William T Smith Lecture. December 3, 2021.

Ohio State University, School of Earth Sciences, Columbus, OH, November 19, 2021.

Environmental Professionals of Iowa. November 16, 2021.

NGWA Darcy Distinguished lecture November 15, 16, 18, 2021, with participants from

- Arcadis consulting, United States
- CDM Smith consulting, United States
- Colorado School of Mines, United States
- Eastern Michigan Univ, United States
- Florida International University, United States
- Florida State University, United States
- Golder Associates USA, United States
- Lre Water consulting, United States
- University of Arizona, United States
- University of Kansas, United States
- US Geological Survey, United States
- US EPA, United States
- Arup Group UK, United Kingdom
- GHD consulting UK, United Kingdom
- Queen's University Belfast, United Kingdom
- The University of the Philippines, The Philippines
- Jorge Basadre Grohmann National University, Peru
- National University of Engineering, Peru
- Earth Tech New Zealand, New Zealand
- Universidad de Cundinamarca, Colombia
- The National University of Colombia, Colombia
- Itasca consulting for geomechanics, hydrogeology, Chile
- Golder Associates Canada, Canada
- Klohn Crippen Berge engineering, geoscience and environmental consulting, Canada, Canada
- Lorax Environmental Service Ltd, Canada
- SRK consulting Canada, Canada
- Université de Sherbrooke, Canada
- Associates (Consulting), Canada
- BGC engineering, Canada
- Matrix-solutions consulting, Canada
- GHD consulting Australia, Australia
- Carbon Count, Australia
- Cardno engineering & Construction, Australia
- CM Jewell & Associates, Australia
- Klohn Crippen Berge engineering, geoscience and environmental consulting, Australia

- New Crest Mining Limited, Australia
- NSW Dept of Planning, Industry and Environment, Australia
- Ren Consulting, Australia
- The Queensland University of Technology, Australia
- Australian Geoscience, Australia
- Kabul Polytechnic University, Afghanistan

University of Alberta, University of Calgary, University of Regina, Simon Fraser University, CANADA. November 12, 2021.

University of Delaware, Department of Earth Sciences, November 11, 2021.

Princeton University, Department of Civil and Environmental Engineering, November 10, 2021.

Great Britain Chapter of International Association of Hydrogeologists (IAH), the Hydro group of The Geological Society (of London), IAH Western & Central European Chapter. November 9, 2021.

National Science Foundation, GEO Directorate Distinguished Lecture & Darcy Distinguished lecture. October 22, 2021.

Geological Society of America annual meeting, Division of Hydrogeology, Portland, OR. October 11, 2021.

Oregon State University, Graduate program in hydrogeology, Corvallis, OR., October 8, 2021.

Grand Valley State University, Grand Rapid, MI, October 4, 2021.

Hope College, Holland, MI, October 4, 2021.

Michigan State University, Department of Earth and Environmental Sciences, October 1, 2021.

Western Michigan University. Department of Geological and Environmental Sciences, October 1, 2021.

Dartmouth College, Department of Earth Sciences, September 23, 2021.

University of Columbia, sponsored by Lamont-Doherty Earth Observatory, Lenfest Center for Sustainable Energy, broadcasted to Department of Earth and Environmental Sciences, Department of Earth and Environmental Engineering, and Barnard College. Darcy Distinguished lecture, September 22, 2021.

University of Pennsylvania, Department of Earth and Environmental Sciences, September 17, 2021

S.S. Papadopoulos & Associates, Inc., September 15, 2021.

Saudi Aramco EXPEC Advanced Research Center monthly webinar series & Darcy Distinguished lecture, May 25, 2021.

Indiana University – Purdue University Indianapolis and organizations in the Wabash basin (Purdue University, University of Illinois Urbana-Champaign, Illinois Geological Survey, USGS Indianapolis office, Hoosier Environmental Council), April 12, 2021.

Los Alamos National Laboratory, Frontiers in Geoscience colloquium series & Darcy Distinguished lecture, March 15, 2021.

University of Cambridge, UK & Earth to Earth seminar series (a UK-wide colloquium consortium sponsored by the University of Cambridge, University of Oxford, and St Andrews University). March 11, 2021.

- King Abdullah University of Science and Technology, Saudi Arabia, February 17, 2021.
- King Fahd University of Petroleum and Minerals, Saudi Arabia. February 3, 2021.
- 2020** U.S. Geological Survey, the Geology, Minerals, Energy, and Geophysics Science Center, with staff located in Arizona, California, Nevada, Oregon, and Washington, webinar, June 11, 2020.
- Environmental Resilience Institute webinar, Indiana University, April 6, 2020.
- Indiana University, Department of Earth and Atmospheric Sciences, February 24, 2020.
- U.S. Geological Survey Indianapolis office and Groundwater Focus Committee, Feb 6, 2020.
- 2019** Texas A&M University, Department of Geology and Geophysics, ConocoPhillips seminar, October 4, 2019.
- Northwest University, Frontier Forum Lectures #905, Xi'an, China, Dec 3, 2019.
- 2018** Laboratory Géosciences de l'Environnement, Toulouse (Université de Toulouse-CNRS), France, June 22, 2018.
- Colorado School of Mines, Van Tuyl lecture, March 15, 2018,
- Indiana University, Department of Earth and Atmospheric Sciences, April 10, 2018.
- Indiana University, School of Public and Environmental Affairs, April 17, 2018.
- 2017** Rensselaer Polytechnic Institute, Department of Earth and Environmental Sciences, Feb 28, 2017.
- UNESCO workshop on karst critical zone, and international training courses with students from 20 countries, keynote speaker, Kunming, China, July 18-20, 2017.
- Chinese Academy of Sciences, Institute of Geochemistry, advances in isotope geology, June 18 – 21, 2017, Guiyang, China.
- Tongji University, Shanghai, China, June 4, 2017.
- China University of Science and Technology, May 20, 2017.
- Jiaxing University, Dec 29, 2017.
- 2016** Southern Methodist University, Dallas, Texas, September 6, 2016.
- Jilin University, Changchun, China, colloquium, May 15, 2016.
- Beijing Normal University, College of Water Resources, Beijing, China, colloquium, May 10, 2016.
- 2015** University of Notre Dame, Department of Civil Engineering and Geological Sciences, departmental colloquium, February 25, 2016.
- Goldschmidt conference, silver anniversary talk, “advances in hydrogeochemistry in the past 25 years”, Prague, Czech Republic, August 16-21, 2015.
- Chinese Academy of Sciences, Institute of Deep Ocean Sciences and Engineering, “New methods in studies of silicate reaction kinetics”, December 23, 2015, Sanya, Hainan Province, China.
- The Second Institute of Oceanography, State Administration of Oceanography, Hangzhou, China, June 9, 2015.
- 2014** Natural Science Foundation of China Forum “Developing Basic Geosciences Programs in China”, Keynote speaker, Chengdu, China, November 13, 2014; Title: “Advancing thermodynamics and kinetics research as a drive for basic geoscience research in China.”

- University of New Hampshire, Durham, NH, October 16, 2014, Title: “Development of Critical Zone science programs in China and Europe and recent advances in measuring silicate reaction rates in the critical zone with silicon isotopes.”
- Keynote speaker, “Earth’s Critical Zone Science” a Forum jointly sponsored by the Natural Science Foundation of China Forum (114th in Shuang Qi series) and Chinese Academy of Sciences (35th in series of Frontiers of Sciences and Technology), Guiyang, China, 9-11 May 2014. Title: Critical Zone formation, structure and evolution, and research emphasis in China.”
- Jinlin University, Forum on geofluids, Changchun, China, September 13, 2014; Title “Recent developments and future directions in water-rock interaction basic and applied research.”
- Tohoku University, Japan, 11th international workshop on WATER DYNAMICS, 11-17, March 2014; Title: “Recent development in dissolution – precipitation kinetics.”
- Geological Survey of China Hangzhou, Center for agricultural geology research, June 4, 2014.
- 2013** Peking University, School of Earth and Space Sciences, China, November 21, 2013.
- Keynote speaker, “Critical Zone Research as a Drive for Basic and Applied Research on Water-rock Interactions in China,” workshop on critical zone processes and their effects on climatic, ecological, and environmental changes, organized by National Natural Science Foundation of China, Nanjing, China, April 22-25, 2013.
- First Joint Scientific Meeting of Geological Society of China and Geological Society of America “CO₂-Water-Rock Interactions during Geological CO₂ Storage,” Chengdu, China, June 17-19, 2013.
- 2012** University of Oslo, Department of Geosciences, Norway, May 3, 2012.
- Chengdu University of Technology, China, May 30, 2012.
- Northwest University of China, June 19, 2012.
- 2011** Woods Hole Oceanographic Institution, October 18, 2011.
- Geological Society of America annual convention, Pardee Keynote Symposium, “Global water sustainability,” Minneapolis, MN, USA, October 9 - 12, 2011.
- University of Illinois at Chicago, Department of Earth and Environmental Sciences, April 14, 2011.
- Ben-Gurion University of the Negev, Israel, March 16, 2011.
- Kent State University, Keynote speaker, “Decoding the disciplines: Helping students through the bottlenecks,” Scholarship of Teaching and Learning (SOTL) program, February 17, 2011.
- Kent State University, Workshop on “Decoding the disciplines: Helping students through the bottlenecks,” Scholarship of Teaching and Learning (SOTL) program, February 18, 2011.
- 2010** Third U.S.-China CO₂ Emissions Control Science & Technology Symposium, Hangzhou, China, December 10-12, 2010.
- National Energy Technology Laboratory, Earth Science Seminar Series, Pittsburgh, PA, November 19, 2010.
- Washington University - St. Louis, “Kinetics of water-rock interactions in geological carbon sequestration,” Department of Energy, Environmental and Chemical Engineering, November 5, 2010.

Indiana University – Bloomington, Scholarship of Teaching and Learning (SOTL) program, “The Case Study Method for the Assessment of Student Learning: Using Scientific Reasoning and Deep Geological Time to Predict Future Environmental Impacts,” September 24, 2010.

Beijing Normal University, Department of Physics, July 15, 2010.

Chinese Academy of Science, Institute of Geochemistry, Guiyang, China, May 25, 2010.

Institute for Study of the Earth's Interior, Okayama University at Misasa, May 18, 2010.

Ohio State University, School of Earth Sciences, April 23, 2010.

Ohio State University, Department of Chemistry, April 22, 2010.

University of Kentucky, The Rast-Holbrook lecture, Department of Earth and Environmental Sciences, March 25, 2010.

Indiana University – Bloomington, Joint seminar, Department of Geological Sciences, Department of Geography, and School of Public and Environmental Affairs, February 4, 2010.

Stanford University’s The Global Climate and Energy Project and USGS sponsored workshop on Caprocks and Seals in Geologic Carbon Sequestration, January 14, 2010.

Schlumberger-Doll Research, Cambridge, MA, January 5, 2010.

2009 Annual Meeting of American Geophysical Union, Invited speaker, “Water in the Critical Zone: Major Elements, Trace Elements, and Isotopes as Biogeochemical Tracers,” Session H24, San Francisco, December 14 – 18, 2009.

Columbia University, Dept. of Earth and Environmental Engineering, New York, Oct. 2, 2009.

Mineralogical Society of America and The Geochemical Society short course “Thermodynamics and kinetics of water-rock Interaction,” Invited lecture, Davos, Switzerland, June 19 – 20, 2009.

University of Warsaw, Lectures and seminars, Faculty of Geology, Poland, May 12- 13, 2009.

University of Oxford, Department of Earth Sciences, England, May 1, 2009.

Norwegian Center of Excellence on “Physics of Geological Processes,” University of Oslo, April 30, 2009.

University of Wyoming, School of Energy Resources & Department of Geology and Geophysics, April 16, 2009.

KTH, Royal Swedish Institute of Technology, Department of Land and Water Resources Engineering, Stockholm, April 3, 2009.

American Chemical Society 237th annual national meeting, invited talk, special session on "Coprecipitation of metals during chemically and biologically induced mineral precipitation," Salt Lake City, UT, March 22-26, 2009.

Ohio State University, invited speaker, “Advances in the Science of carbon Sequestration,” meeting, Schlumberger, Battelle, AEP, Columbus, Ohio, March 9 – 10, 2009.

Hoosier Environmental Council, Inaugural lecture for “Hoosier Environmental Council Policy Forum Series”, Feb. 27, 2009.

University of Notre Dame, Department of Civil Engineering and Geological Sciences, January 22, 2009.

- 2008** University of Albert-Ludwig University, Institute of Mineralogy and Geochemistry, Germany, December 16, 2008.
- Swiss Federal Institute of Aquatic Science and Technology, Department of Water Resources and Drinking Water, November 4, 2008.
- Academia Sinica, Center for Environmental Changes, Taipei, Taiwan, October 29, 2008.
- National Taiwan University, Department of Geological Sciences, Taiwan, October 28, 2008.
- China University of Geosciences, Wuhan, China, October 25, 2008.
- Annual National Meeting of Petrology and Geodynamics, plenary address, 2008, Guiyang, China, October 19, 2008.
- China University of Oceanography, October 16, 2008.
- University of California – Berkeley, Dept. of Earth and Planetary Sciences, April 24, 2008.
- Lawrence Livermore National Laboratory, Geochemistry Div., January 17, 2008.
- Lawrence Berkeley National Laboratory, Div. of Earth Sciences, January 9, 2008.
- 2007** ExxonMobil Upstream Research Company, “Modeling Water-rock Interactions with Applications to Geological Carbon Sequestration, EOR, and Diagenesis,” Houston, July 18, 2007.
- Chengdu University of Technology, June 6, 2007.
- Chinese Academy of Sciences, Institute of Geochemistry, May 31, 2007.
- Zhejiang University, Department of Earth Sciences, May 24, 2007.
- Zhejiang University of Technology, College of Biological and Environmental Engineering, May 22, 2007.
- University of Oregon, Department of Geological Sciences, Eugene, March 7, 2007.
- 2006** Indiana University – Bloomington, “Recharge at Yucca Mountain, Nevada: The Science, Policy, and the Court,” School of Public and Environmental Affairs, Seminar Series on Environmental Science and Policy, October 5, 2006.
- 2005** Geological Society of America Annual Meeting Topical Session “Paleohydrogeology and paleoclimate – looking into the past”, Salt Lake City, Utah, October 16-19, 2005.
- Ohio State University, Department of Geological Sciences, April 21, 2005.
- U.S. Nuclear Regulatory Commission, invited presentation before the Advisory Committee on Nuclear Waste, Rockville, Maryland, December 13, 2005
- Anglo Research, Quarterly seminar in chemistry, Johannesburg, South Africa, November 24, 2005.
- Okayama University at Misasa, Japan, Institute for Study of the Earth's Interior, June 20, 2005.
- Nanjing University, China, July 4, 2005.
- Beijing University, China, July 7, 2005.
- Zhejiang University, China, July 1, 2005.
- International Conference on Safe Water (SAFEWATER 2005), San Diego, California, October 21,

- 2004** Swiss Federal Institute of Technology, Institute of Mineralogy and Isotopes, Zurich, Switzerland, April 13, 2004.
Paul Scherrer Institut, Villigen, Switzerland, June 24, 2004.
Institute of Earth Sciences Jaume Almera, Spanish Research Council (CSIC), Barcelona, Spain, April 22, 2004.
Indiana University-Purdue University Indianapolis (IUPUI), Department of Geological and Environmental Sciences, October 12, 2004.
Western Michigan University, Kalamazoo, Michigan, September 27, 2004.
- 2003** PITTCON, invited speaker on chemical modeling, Orlando, Florida, March 14, 2003.
PPG Industries, corporation remediation group.
U.S. Steel Corporation, Corporate environmental affairs manager meeting.
- 2001** Carnegie Mellon University, Department of Civil and Environmental Engineering.
Southwest Research Institute, Center for Nuclear Waste Regulatory Analyses.
University of Pittsburgh, Department of Mathematics, Numerical Analysis Group.
Pittsburgh Geological Society.
University of Minnesota.
- 2000** George Washington University, Department of Environmental Earth Sciences.
University of Pittsburgh, Department of Geology and Planetary Science.
American Geophysical Union Annual Meeting, invited talk in a special session
- 1999** Southwest Research Institute, Center for Nuclear Waste Regulatory Analyses.
- 1998** U.S. Geological Survey, Lakewood, Colorado.
U.S. Geological Survey, Arizona District Office, Tucson.
U.S. EPA, Robert S. Kerr Environmental Research Laboratory.
Old Dominion University.
Rensselaer Polytechnic Institute.
- 1997** University of Missouri-Rolla.
Mobil Oil Company.
BHP Copper USA, Tucson, AZ.
- 1996** Colorado Groundwater Association.
- 1994** Unocal Geothermal.
U.S. Geological Survey, Menlo Park.
- 1993** Invited talk at Geological Society of America Annual Meeting.
Pacific Northwest National Laboratory.
University of Illinois-Chicago.
Queens College.
- 1991** Woods Hole Oceanographic Institution.

University of Mississippi.

COURSES TAUGHT

Undergraduate Courses

Global Water Resources (H241)

20S (18) as an honors course (H241). 20F (18, Honors courses are capped at 22) as an honors course (H241). 21S (18, Honors courses are capped at 22) as an honors course (H241).

Sustainability: Water Resources (E118)

I developed this new course and first offered it in fall 2015. The course carries General Education credits for Natural Sciences and Mathematics.

Water resources are critical to sustaining life but this resource is increasingly at risk because of growing competition among domestic, industrial-commercial, and agricultural needs. Students will master the subject of water resources first through the studies of water's role in the earth systems, the use of water budget (the hydrologic equation) for quantitative analysis, and analysis of both historic and geologic data. Students will then analyze the human-water resources interactions from the baseline of a thorough understanding of the physical world of water and quantitative and problem-solving skills acquired from handling uncertain and incomplete data. In the end, students will be able to take a holistic approach to a complex issue.

I have taught this course in the following semesters (enrollments in parenthesis): 2015F (38), 2016 (33), 2016F (34), 17S (37), 18F (35), 19S (19);

Environmental Geology (G171)

This is an introductory level, service course for non-science majors. The course has a large enrollment and includes both lectures and laboratories. Many students take this course to fulfill requirements for a B.A. degree in education, business, social sciences, or the humanities. Students are introduced to the following concepts: the scientific method, dynamic earth systems, and geological processes related to global climate changes, water resources, environmental contamination, and the hazards of earthquakes, landslides, floods, and volcanos. My duties also include supervising Associate Instructors.

I have taught this course in the following semesters (enrollments in parenthesis): Fall12 (19), Spring12 (25), Fall11(25), Fall10 (25), Fall09 (43), Fall06 (37), Fall05 (98*). *as an 8-week course.

Principles of Hydrogeology (E451)

This is an advanced undergraduate and introductory graduate-level course. This course introduces the principles and practices of physical and chemical hydrogeology. It includes both lectures and laboratories. I teach the laboratories.

I have taught this course in the following semesters and at the following institutions: Spring18 (9), Spring13 (6), Spring12 (4), Spring11 (6), Spring10 (11), Fall04 (10) Spring06 (8), Spring07 (6) at Indiana University; Spring02 (11) and Spring01 (25) at University of Pittsburgh; Spring99 (6) at Old Dominion University. The class was co-taught in the academic year of 2004 and 2007.

Graduate Courses

Aqueous Geochemical and Modeling (E586/E486)

In 2020, I revised this course to be a course for both upper-level undergraduate and graduate students. The scope includes chemical principles and modeling of chemical reactions in the environmental and geological systems and processes. Students will learn how to calculate the mineral solubility, construct a pH-Eh diagram, and simulate a laboratory experiment with chemical modeling software. Students also acquire necessary skills for interpretation of water quality and water chemistry data from the field and laboratory experiments in support of thesis research. The course includes an intensive laboratory that I teach.

I have taught this course in the following semesters at the following institutions: Fall17 (3), Fall15 (5), Fall09 (7), Spring07 (5), Spring05 (14) at Indiana University; Spring08 (14) at Swiss Institute of Technology at Zurich (ETH); and Fall02 (7) at University of Pittsburgh.

Other Courses

Honors Research in Geology (G499)

I supervised an undergraduate student, Kyle Brown, in Fall 2004 in the honors program. I supported his research in my laboratory from extramural grants for research costs and with a stipend. I helped him obtain an “Honors College Undergraduate Research Grant.”

G490 (32281) Undergraduate Seminar

This was a special situation. We had a highly motivated student who wished to learn chemical hydrogeology from me while I was on a Fulbright Scholarship in Norway. We “met” weekly through video conference via Skype. 3 credits, 1 student (Dalton Hardisty), Spring 2009.

Mineralogy

I taught this course at Old Dominion University. This is a core course of geology’s curriculum. Understanding mineralogy is essential for studying the formation and properties of rocks and for understanding what controls the properties of fluids that interact with minerals. I taught this course twice. The enrollments were 20 to 30 students. The course included an intensive laboratory. My duties also included developing laboratory teaching materials and supervision of a Teaching Assistant.

SHORT COURSES TAUGHT

Invited Short Course

October 21 – 24, 2014, China University of Geosciences, Beijing. Graduate students participated in a series of lectures on water-rock interaction, scientific writing.

Invited Short Course on *Geochemical Modeling*

August 27 – 28, 2014, Szeged University, Hungary. Twenty-four professors, scientists, and graduate students from Hungary participated.

March 11, 14 – 15, 2011, Ben-Gurion University of the Negev, Israel. Twenty-four professors, scientists, and graduate students from the Hebrew University of Jerusalem, Ben-Gurion University of the Negev, and the Israeli Geological Survey participated.

November 21 – 23, 2005, University of the Witwatersrand, Johannesburg, South Africa. The sixteen participants attended from the University of the Witwatersrand, University of Free State, University of Swaziland, Masaryk University of Czech Republic, Anglo Platinum, Angola Gold Ashanti, South Africa Nuclear Energy Corporation, Eskom (the largest electric utility company in Africa), SRK Consultants, and Golder Consultants.

WEBINAR

National Groundwater Association, January 18, 2017, The topic is "geochemical modeling". 27 participants from the United States and Canada took the webinar and they could take continuing education credits. *Pro bono*

GUEST LECTURES

Guest Lectures, School of Public and Environmental Affairs, E555 Energy systems engineering, November 6 and 9, 2011

Guest Lecture, Okayama University, Japan, 6 graduate students, “Editorial processes at some journals and how to write a scientific paper,” June 29, 2010

Guest lectures, University of Oslo, Norway, GEO9900 - Chemical processes in soil and ground water, ~10 students, “Groundwater flow and solute transport modeling” and “Laboratory on modeling,” March 27, 2009

Guest lecture, University of Warsaw, Poland, guest lectures in which students earn one credit hour toward to their degrees, “Responses of groundwater systems to paleoclimate changes from late Pleistocene to Holocene,” “Recharge rates at Yucca Mountain, Nevada: The science, the politics, and the court,” and “A new hypothesis for the apparent field-lab discrepancy on feldspar weathering rates,” May 12 – 13, 2009

Guest lecture, Okayama University, Japan, freshman course Evolution of the Earth, ~80 students, “the subduction zone factory,” June 24, 2005

Invited Lecture, Okayama University, Japan, 25 graduate students, “An Introduction to Thermodynamic and Kinetic Calculations and Modeling,” June 2005

Invited Lectures, Beijing Normal University, China ~20 graduate students, “An Introduction to Geochemical Modeling,” July 4 - 6, 2005

Guest lecture, “Modeling activity coefficient models for saline brine” for E539 Aquatic Chemistry, School of Public and Environmental Affairs, Indiana University – Bloomington, March 31, 2005

Guest lecture, “Modeling surface adsorption” for E539 Aquatic Chemistry, School of Public and Environmental Affairs, Indiana University – Bloomington, April 28, 2005

Guest lectures “Aqueous geochemistry” for G406 An Introduction to Geochemistry, Department of Geological Sciences, Indiana University – Bloomington, September 13, 15, 17, 2004

PEDAGOGICAL STUDIES AND SCHOLARSHIP OF TEACHING AND LEARNING

- Fellow of the *Freshmen Learning Project*, 2005. A two-week project designed to work with colleagues in order to develop strategies on how to teach students in large freshmen classes and important threshold concepts.

- ***Learning Deep Geological Time in Environmental Geology.*** On-going research to design and conduct laboratories and teaching methods based on the concept of deep geological time to freshmen in the Course G171 Environmental Geology. Collected pre- and post-knowledge survey data, and analyzed laboratory reports and examinations in order to evaluate the effectiveness of a lab which encouraged students to visualize the immensity of deep geological time. This is in collaboration with George Rehrey, Brooke Treadwell, and Claudia Johnson and part of my efforts related to the Freshmen Learning Project and the Scholarship of Teaching and Learning
- Simon Brassell, Jeremy Dunning, Bruce Douglas, Claudia Johnson, Jim Brophy, Michael Hamburger, and Chen Zhu (Geology) were provided an exploratory research grant to collaborate on the project Teaching Geological Fundamentals: An Assessment of the Effectiveness of Varied Pedagogical Approaches Coupled to Student Learning. This research will take a comprehensive look at student learning in 100-level geology courses and develop specific pedagogical strategies for teaching the geological principles that are critical to students' success in those courses. It will also determine which strategies can best accommodate a range of student learning styles when teaching key geological principles. Results from this work will be incorporated into new or redesigned courses that meet general education requirements. Anticipated project outcomes include an assessment of the impact of student learning styles upon the comprehension of geological concepts, the creation of classroom interventions that will assist student learning of those concepts, course revisions based upon a learning outcome analysis, and the creation of an exhibit about geological time.
- Participant in the successful proposal of "College 2010 Fall Themester: Sustainability: Global Challenges and local solutions." Bundled G171 Fall with the "Themester" program. The "Themester" (the theme of the semester) is a new initiative in the college.

STUDENT AND POST-DOCTORAL TRAINING

Student Awards

LU Peng (2021), Kharaka Award, International Association of GeoChemistry (IAGC). The IAGC Kharaka Award is bestowed annually to deserving scientists from developing countries.

Post-doctoral Advisees

Jennifer Dierauer Brand (1/2019-8/2019, left the position earlier because of the TT position offered to her), *currently*: Assistant Professor, U of Wisconsin – Stevens Point.

Guanru Zhang (7/2016-9/2018), *currently*: Associate Professor, Chengdu University of Technology

Zhaoyun Liu (11/2013-6/2015), *currently*: Zhejiang Geological Survey

Chao Wang (3/2012 -3/2013), in an environmental consulting firm

Zuoping Zheng (2006-07), *Currently*: Senior Environmental Scientist, Garratt-Callahan Company, an environmental consulting firm, San Francisco, California.

Changbing Yang (2006-07), *Currently*: Research scientist, Texas Bureau of Economic Geology.

Hiromi Konishi (2004-05), *Currently*: Professor, Department of Geology, Niigata University, Japan

Victor Bense (2004-05, 50% time), *Currently*: Associate Professor, Wageningen University, The Netherlands

Ph.D. Graduate Student Committee, Chaired or co-chaired

Zhang Yilun (Ph.D. 2019), Environmental Sciences, Indiana University
Dissertation topic: “An experimental and modeling study of silicate dissolution kinetics near-equilibrium”. He co-authored 12 articles with Chen Zhu.

Currently: senior environmental chemist, InterTech, China

√Bin Hu (Ph.D. 2019) Beijing Normal Univ & Indiana University
Dissertation Title: “Thermodynamic and kinetic databases for geochemical modeling”

Currently: Post-doc researcher, Chinese Academy of Sciences

√Jingting Kang (Ph.D. 2019) the China Univ of Science and Technology & Indiana University
Dissertation topic: “Innovative use of barium isotopes for kinetics studies”

Currently: Associate Research Professor, China Univ of Science and Technology

√Jingrui Wang (Ph.D. 2019) Beijing Normal University & Indiana University
Dissertation Title: “Evaluating precipitation products for hydrologic modeling over a large river basin in the Midwestern USA”

Currently: Post-doc researcher, Tsinghua University, China

√Guanru Zhang (Ph.D. 2016) Northwest A&M University (China) & Indiana University
Dissertation Title: “Simulation of CO₂ plume migration at the Sleipner project, Norway”

Currently: Associate Professor, Chengdu University of Technology

√Wei Yan (Ph.D. 2016) co-chair, China University of Geoscience (Beijing) & Indiana University
Dissertation topic: “Dolomitization and paleoecosystems”

Currently: Scientist, Bureau of Oceanography, China

He Hongtao (Ph.D. 2015) co-chair, Chinese Academy of Sciences

Dissertation Title: “Silicon isotope fractionation during silicate dissolution and precipitation”

Peng Lu (Ph.D. 2010), Geological Sciences, Indiana University

Dissertation Title: “Coupled feldspar dissolution and clay mineral precipitation kinetics and coprecipitation of lead with nano-particles of iron oxyhydroxides”

Currently: senior geochemist, EXPEC Advanced Research Center, Saudi Aramco Oil Company

^vThese students work under an agreement between China Scholarship Council (CSC) and Indiana University (and most major universities in the US) that they conduct dissertation research in the US and obtain a degree from their host universities. Their dissertation research was supervised by me.

M.S. Graduate Student Committee chaired (*supported from external grants awarded to Zhu)

*McKailey Sabaj (M.S. Jan 2021-)

Thesis topic: “Barium isotope exchange near solubility equilibrium”

Yanyan Chen (M.S. May 2012)

Thesis topic: “Competitive metal coprecipitation with ferrihydrite nano-particles”

Currently: Scientist, PetroChina

Poonam Giri (M.S. May 2011)

Thesis topic: “Numerical modeling of plagioclase feldspar dissolution and secondary mineral precipitation as a function of Al(aq) in CO₂ saturated systems”

Faye Liu (M.S. May 2011)

Thesis Title: “Antimony speciation and contamination of waters in Xikuangshan Sb mining and smelting area, China”

Lynn Means (M.S. 2009, co-chaired with Professor Lisa Pratt.)

Thesis Title: “Mineral rings enclosing an evaporitic lake in Warner Valley, Oregon, USA”

*Anne Hereford (M.S. 2007)

Thesis Title: “Reactions and reaction rates in the regional aquifer beneath the Pajarito Plateau, north-central New Mexico”

*Mathew Reeder (M.S. 2006)

Thesis Title: “Geochemical evolution and in situ reaction rates during a field biostimulation experiment”

Graduate Student Committee member

Jonas Toupal (Ph.D. - present)

University of Pennsylvania

Bryan Wathen (M.S. 2020)

Department of Earth and Atmospheric Sciences, Indiana University

Joshua Barna (M.S. 2020)

Department of Geological Sciences, University of Kentucky

SERVICE

(Some information found on pages 1 and 2 is repeated here for completeness)

U.S. GOVERNMENT

2005, Invited expert public presentation before Advisory Committee on Nuclear Waste, U.S. Nuclear Regulatory Commission, Rockville, Maryland, December 13, 2005

NATIONAL/INTERNATIONAL/PROFESSIONAL/DISCIPLINARY

Associate Editorship and Guest Editorship

2005-21, *Geochimica et Cosmochimica Acta*, Associate Editor
2002-06; 2008-2017, *Journal of Contaminant Hydrology*, Member of Editorial Board
2017-19, *Chemical Geology*, Member of Editorial Board
2003-05, *Ground Water*, Associate Editor; 2021-

International/national Advisory Committee

2006, AquaTRAIN, the FP6 Marie Curie Research Training Network on "Geogenic Chemicals in Groundwater and Soils", European Union.
2007-08, Member, National Ground Water Association's Carbon Sequestration Task Force,

Panel Membership

2021, NSF, graduate fellowship review panel
2019, NASA, member, proposal review panel
2018, National Science Foundation, member, proposal review panel
2013, Natural Science Foundation of China, member, proposal review panel
2013, National Science Foundation, member, proposal review panel
2006, National Science Foundation, member, proposal review panel
2006, Department of Energy, member, proposal review panel for Groundwater Reactive Transport and Simulation Component of the Scientific Discovery through Advanced Computing (SciDAC) Program, the Office of Advanced Scientific Computing Research, April 14, 2006.
2003, U.S. Environmental Protection Agency, member, proposal review panel for Small Business Innovation Research
2001, U.S. Environmental Protection Agency, member, proposal review panel for establishing a hazardous mining waste research center

Review for Funding Agencies

- *U.S. National Science Foundation*
- *U.S. Environmental Protection Agency*
- *Sea Grant*
- *Department of Energy*
- *American Chemical Society/Petroleum Research Fund*
- *Israel Science Foundation (ISF)*
- *Swiss National Science Foundation*
- *the Netherlands Organization for Scientific Research*
- *Czech National Science Foundation*

- *Shota Rustaveli National Science Foundation, Republic of Georgia*
- *The Global Climate and Energy Project (GCEP), Stanford University*
- *Estonian Science Foundation*

Chaired Sessions at National and International Meetings

- 2019 Co-convener, American Geophysical Union Annual Meeting, December 9-13, 2019, San Francisco, “V021 - Fluid-rock reactions in the crust: new data and methods in mineralogy, geochemistry, thermodynamics, and kinetics”
- 2018 Co-convener, Geological Society of America annual meeting, November 4-7, Indianapolis, Indiana, “T99. Five Decades of Impactful Ideas in Hydrogeology: Recognizing the Contributions of Frank Schwartz”
- 2018 Co-convener, Geological Society of America annual meeting, November 4-7, 2018, Indianapolis, Indiana, “T6: Critical Zone Science in Karst and Carbonate Terrains”
- 2017 Co-chair of the scientific committee, Geochemistry of Earth’s Surface (GES-11), July 16-21, 2017, Guiyang, China
- 2015 Co-chair, Theme “Hydrogeochemistry”, Goldschmidt Conference - the Annual Meeting of the Geochemical Society and European Association of Geochemists, August 16-21, 2015, Prague, Czech Republic.
- 2014 Co-chair, “Earth’s Critical Zone Science” a Forum jointly sponsored by the Natural Science Foundation of China Forum (114th in Shuang Qi series) and Chinese Academy of Sciences (35th in series of Frontiers of Sciences and Technology), Guiyang, China, 9-11 May 2014.
Session chair, theme 9 “Geochemistry of earth’s surface”, August 18-2, 2014, Paris, France.
- 2013 Session co-chair, Session 23h “Coprecipitation: Mechanisms and Quantitative Models,” Goldschmidt Conference – the Annual Meeting of the Geochemical Society and European Association of Geochemists, August 25 – 30, 2013, Florence, Italy.
Session co-chair, “water-rock interaction kinetics”, and “thermodynamics of water-rock interaction,” 14th symposium on water-rock interaction, June 9-14, 2013, Avignon, France.
Organizing committee, First Joint Scientific Meeting of Geological Society of China and Geological Society of America, June 17-19, 2013, Chengdu, China.
- 2012 Organizing committee, First Joint Scientific Meeting of Geological Society of China and Geological Society of America, June 17-19, 2013, Chengdu, China.
- 2011 Co-chair Theme 21 “Hydrogeochemistry and global sustainable water resources,” Annual Goldschmidt Conference – the Annual Meeting of the Geochemical Society and European Association of Geochemists, August 14 – 18, 2011, Prague, Czech Republic.
Chair session “Global water sustainability,” Goldschmidt Conference – the Annual Meeting of the Geochemical Society and European Association of Geochemists, August 14 – 19, 2011, Prague, Czech Republic.
Co-Chair, Pardee Keynote Symposium “Global Water Sustainability,” Annual Meeting of the Geological Society of America, October 9 -12, 2011 Minneapolis – St. Paul, Minnesota, USA.

- Co-chair, topical session T121 “Uranium ore deposits: from genesis to mine tailings and mining wastes,” Annual Meeting of the Geological Society of America, October 9 -12, 2011 Minneapolis – St. Paul, Minnesota, USA.
- 2010 Co-chair, Session 14c “Hydrogeochemical Modeling of Reaction Networks in the Critical Zone,” Annual Goldschmidt Conference – the Annual Meeting of the Geochemical Society and European Association of Geochemists, June 13 – 18, Knoxville, Tennessee.
- Co-chair, Session 09f “Geochemistry of CO₂ sequestration”, Annual Goldschmidt Conference – the Annual Meeting of the Geochemical Society and European Association of Geochemists, June 13 – 18, Knoxville, Tennessee.
- 2009 Co-convener, American Geophysical Union annual fall meeting, session, “H36, CO₂-Water-Rock Interactions in Geologic Storage Formations and Secondary Migration Sites” San Francisco, December 14 -18, co-sponsored by the Hydrology, Biogeosciences, and Global Environmental Change Divisions.
- 2008 Chair, ACEME08 - Second International Conference on Accelerated Carbonation for Environmental and Materials Engineering, “CO₂ capture”, the University of Rome “La Sapienza,” Oct 01-03, 2008, Rome, Italy.
- 2006 Co-chair, 16th Annual Goldschmidt Conference – the Annual Meeting of the Geochemical Society, “Water-rock interactions in aquifers: reactions, rates, controls,” August 27-September 1, 2006, Melbourne, Australia.
- Co-convener, West Pacific Geophysics Meeting, American Geophysical Union, VGP11 “Fluid Geochemistry associated with CH₄ hydrate, CO₂ sequestration and hydrothermal mineralization,” July 24 – 27, 2006, Beijing, China.
- 2005 Convener, Geological Society of America session, “T11. Precipitation, dissolution, and redox reaction kinetics in aquifers,” Annual Meeting in Salt Lake City, Utah, October 16-19, 2005. Sponsored by the Geochemical Society, the Hydrogeology Division of the Geological Society of America, and the Geobiology and Geomicrobiology Division of the Geological Society of America.
- 2003 Convener, AGU-EGS-EUG joint assembly, HS38, “Nuclear waste disposal: integrating chemical, hydraulic, and thermal data to determine flow and transport in variably-saturated subsurface media,” April 7-11, 2003, Nice, France.
- Co-organizer, Geological Society of America session T54, “Geochemical modeling of arsenic speciation, transformation, and reactive transport in groundwater,” Annual Meeting, October 27-30, 2003, Seattle, Washington.
- 2002 Convener, Geological Society of America session, “Experimental, field, and modeling studies of geological carbon sequestration,” Annual Meeting, October 27-30, 2002, Denver, Colorado.
- Convener, Pittsburgh Coal Conference, Poster Session, September 23-27, 2002 Pittsburgh, PA.
- 1999 Convener, Geological Society of America session, “Applications of advanced geochemical modeling to mining-related environmental issues,” October 25-28, 1999, Denver, Colorado.
- Co-convener, American Geophysical Union annual spring meeting, special session H51E, “Innovative applications of geochemical modeling to groundwater contamination problems,” May 31-June 4, 1999, Boston, Massachusetts.

UNIVERSITY/COLLEGE SERVICE

2015-21, Faculty chair, Bachelor’s degree in environmental sciences;

2021-present, Member of committee, Bachelor's degree in environmental sciences;
2019-2021, Member of tenure committee of College of Arts and Sciences
2013, Sabbatical leave review committee, VPFAA
2011-13, Member, executive committee, Center for Research in Environmental Sciences

DEPARTMENT SERVICE

2021-22, Member, Owen's award committee
2020-21, Member, instrument task force, Owen's award committee
2019-20, Member, promotion committee for a colleague from associate to full professor
2019-20, Member, promotion committee for a colleague from lecturer to senior lecturer
2019-20, Organizer, departmental colloquium
2018-19, Member, field station committee
2016-17, Member, policy committee
2016-17, Member, space committee
2015-16, Member, tenure committee
2015-16, Member, the search committee for a faculty position in surficial processes and hydrological sciences
2013-14, Member, MSBII space committee
2011-13, Chair, departmental weekly colloquia
2009-11, Chair, Curriculum Committee
2005-06, Member, Owen Award Committee
2005-07, Member, Associate Instructor Assignment Committee
2004-05, Member, undergraduate curriculum sub-committee
2004-05, Faculty meeting recorder
2001-03, Liaison to university libraries, responsible for revamping earth science subscriptions
2002-03, Member, Search committee, environmental scientist
2001-02, Member, Search Committee, planetary scientist
2001-02, Member, Search Committee, astrobiology
2001-03, Member, Geographic Information System committee
2000-03, Member, Planning, and budget committee
2000-03, Member, Computer committee
2000-01, Member, Search Committee, planetary scientist
2000-01, Member, Search Committee, sedimentologist
1999-2000, Member, Search Committee, biological oceanographer
1999-2000, Member, Graduate program curriculum committee
1999-2000, Recruitment of freshmen
1998-99, Member, department chair search committee

COMMUNITY OUTREACH

2021 Panelist for "Next generation groundwater professionals" event for early career hydrogeologists at the Groundwater Week organized by NGWA.
2021 Served as panelist for Indiana University Rural Conference on the panel "Rural Indiana's drinking water: problems and responses". The conference was organized by Indiana University's Center for Rural Engagement.
2020 Developed online instruction exercises for K-12 students, together with students in my H241 class. Indiana University distributed the course information to science teachers in Indiana
2007 Guest lecture on Water Resources on the Earth, Angelu Elementary School, Hangzhou, China, May 25.
2006 Guest lecture on water, Summit Elementary School, Bloomington, Indiana, January 2006.

- 2001 Lecture/seminar “Geological carbon sequestration as a strategy to abate the global warming trend” for the “Minority Access to Research Seminars” at Hampton University, Hampton, Virginia, November 14, 2003.
- 2002 Outreach, guest lecture of “minerals and rocks” at the Cyert Center for Early Childhood Development, Carnegie Mellon University, Pittsburgh, April 2001.
- Outreach, tour guide for the mineral exhibit at the Carnegie Museum of Natural History for children from the Cyert Center for Early Childhood Development, Carnegie Mellon University, Pittsburgh, October 9-10, 2001.