

CURRICULUM VITAE

Xinning Zhang

Assistant Professor
Department of Geosciences
Princeton Environmental Institute
M47 Guyot Hall, Princeton University
Princeton, NJ 08544

xinningz@princeton.edu
office: (609) 258-2489
<http://scholar.princeton.edu/xinningz/>

EDUCATION and TRAINING

- Postdoctoral: Princeton University, Princeton NJ 2011–2014
Dept. of Geosciences
Advisor: Dr. François Morel
- California Institute of Technology, Pasadena, CA 2010–2011
Division of Geological and Planetary Sciences
Advisor: Dr. Alex Sessions
- Graduate: California Institute of Technology, Pasadena, CA 2004–2010
Ph.D. Environmental Science and Engineering
Thesis advisor: Dr. Jared Leadbetter
- Undergraduate: Cornell University, Ithaca, NY 2000–2004
B.S. *summa cum laude* Biological and Environmental Engineering
- Other training: Marine Biological Laboratory, Woods Hole, MA 2008
Microbial Diversity Course, summer student

PROFESSIONAL EXPERIENCE

- Princeton University, Princeton NJ
Assistant Professor 2017– present
Dept. of Geosciences and the Princeton Environmental Institute
- Associate Research Scholar 2014–2017
Dept. of Geosciences

TEACHING EXPERIENCE

- Princeton University
ENV200F – Environmental Nexus (Science and Technology section) 2017-present
GEO416/ENV418– Microbial Physiology: A geobiological view 2018-present
- California Institute of Technology
Microbial Physiology (teaching assistant, laboratory instructor) 2006–2008

RESEARCH GRANTS

- NASA – *Exobiology (grant 80NSSC17K0667)* 2017–2020
What controls the nitrogen isotope fractionation of N₂ fixation? (PI)
- Princeton Environmental Institute – *Carbon Mitigation Initiative* 2017–2020

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| Investigations of wetland methane production (PI) | |
| <i>National Science Foundation – Geobiology (EAR grant 1631814)</i> | 2016–2019 |
| Alternative nitrogenases: How much do they contribute to N ₂ fixation and why? (Co-PI) | |
| <i>Princeton Environmental Institute – Grand Challenges Investigator Award</i> | 2015–2017 |
| Controls on Alternative Nitrogen Fixation (Co-PI) | |
| <i>Tuttle Invertebrate Research Fund, Dept. Geosciences, Princeton University</i> | 2014–2017 |
| The role of alternative nitrogenases in termites | |

AWARDS

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| National Science Foundation Graduate Research Fellowship | 2004–2007 |
| Benjamin Rosen Graduate Student Fellowship, California Institute of Technology | 2004 |
| Cornell Presidential Research Scholar | 2000–2004 |

SYNERGISTIC ACTIVITIES

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| Convener, Session B092 Nitrogen Biogeochemistry, AGU Fall meeting | 2018 |
| Lab host for Watershed Institute’s Climate Change Academy | 2018 |
| HHMI Film Interview: “I Contain Multitudes – termite gut microbes” by Ed Yong | 2017 |
| Introducing non-science majors to science and technology of climate, biodiversity, food, and water problems (ENV 200F) | 2017-present |
| Princeton Women in Geosciences | 2015–present |
| steering committee | 2015–2016 |
| mentor | 2017-present |
| Environmental Geology & Geochemistry Seminar coordinator, Princeton | 2015–2016 |
| Caltech Women Mentoring Women Program (mentor) | 2010–2011 |
| Journal ad hoc reviewer: | ongoing |
| <i>Applied and Environmental Microbiology, Environmental Microbiology, FEMS Microbiology, Organic Geochemistry, Geochimica et Cosmochimica Acta, PNAS, Nature journals</i> | |
| Invited Editor (mBio): | |
| <i>Wehrmann et al (2017) Functional role of lanthanides in enzymatic activity and transcriptional regulation of pyrroloquinoline quinone-dependent alcohol dehydrogenases in Pseudomonas putida KT2440. mBio 8:e00570-17</i> | |
| Proposal Reviewer: | |
| <i>NSF, DOE, American Chemical Society, Schlumberger - ad hoc</i> | ongoing |
| <i>DOE – SBR Biogeochemistry panel review</i> | 2017 |
| <i>DOE- EMSL Breakthrough Science & Technology Workshop</i> | 2017 |

Member of ASM, AGU, European Association of Geochemistry, Metabolomics Society

MENTORING

Postdoctoral Researchers - Romain Darnajoux, Jared Wilmoth, Ashley Maloney.
Graduate Students (primary advisor) -Katja Luxem, Eunah Han.
Graduate Students (committee mentor) - John Tracey, Julia Carroll, Naomi Intrator, Zachary Garvin, Yeongjun Ryu, Ryan Manzuk.
Undergraduate Students-Xin Rei Zhang, Henry Ogilby, SiSi Peng, Kayla Dobies, Kelly Van

Baalen, Carol Chiu, Allison Lee.

INVITED LECTURES

2017–

- Department seminar, Dept. of Earth Sciences, University of Southern California, CA
- Wolman Seminar, Dept. of Environmental Health and Engineering, Johns Hopkins University, MD
- Tracing Biogeochemical Cycles From Enzyme To Ecosystem (session keynote), Goldschmidt Conference, Paris, France
- Modern Microbes: Portals to Ancient Worlds session, Geobiology Society Conference, Banff, Canada
- DOE - Breakthrough Science and Technologies workshop, Richland, WA

2016–

- School of Oceanography, University of Washington – Seattle, WA
- Department of Environmental Sciences, Rutgers University, NJ
- Biogeochemistry, Environmental Sciences & Sustainability Seminar, Cornell University, NY
- Geosciences Department, Princeton University, NJ

2015–

- Bio-isotopic Message in a Rock Record Bottle session, AGU annual meeting, CA
- Earth and Environmental Science Department, University of Pennsylvania, PA
- NOAA-Geophysical Fluid Dynamics Laboratory, NJ
- Department of Environmental Science, American University, Washington DC
- Microbial Systems Seminar Series, Parsons Lab, MIT, MA
- Civil and Environmental Engineering, Temple University, PA
- Environmental Geology and Geochemistry seminar, Princeton University, NJ

2011–

- Remsen-Bird Lecture, Occidental College, CA

2010–

- Goldschmidt Conference, Davos, Switzerland (*declined*)

PUBLICATIONS

2018

- 1) McRose, D.L., Lee A., Kopf S.H., Baars O., Kraepiel A.M.L., Sigman D.M., Morel F.M.M., **Zhang X.** (2018) Effect of Iron Limitation on the Isotopic Composition of Cellular and Released Fixed Nitrogen in *Azotobacter vinelandii*. *Geochimica et Cosmochimica Acta*. 24:12-23. DOI: 10.1016/j.gca.2018.09.023
- 2) **Zhang X.**, Baars O., Morel F.M.M. (2018) Genetic, structural, and functional diversity of low- and high-affinity siderophores in strains of nitrogen fixing *Azotobacter chroococcum*. *Metallomics*. DOI: 10.1039/c8mt00236c
- 3) Baars O., Morel F.M.M., **Zhang X.** (2018) The purple non-sulfur bacterium *Rhodospseudomonas palustris* produces novel petrobactin-like siderophores under aerobic and anaerobic conditions. *Environmental Microbiology* 20:1667-1676. DOI: 10.1111/1462-2920.14078
- 4) Baars O., **Zhang X.**, Stone A. T., Morel F.M.M., Seyedsayamdost M. (2018) Crochelins, siderophores with a novel iron-chelating moiety from the nitrogen-fixing bacterium

Azotobacter chroococcum. *Angewandte Chemie*. 57(2):536-541. DOI: 10.1001/anie.201709720/epdf

Up until 2017

- 5) McRose D.L., **Zhang X.**, Kraepiel A.M.L., Morel F.M.M. (2017) Diversity and activity of alternative nitrogenases in sequenced genomes and coastal environments. *Frontiers in Microbiology: Aquatic Microbiology*. 8:267 DOI: 10.3389/fmicb.2017.00267
- 6) Darnajoux R., **Zhang X.**, McRose D.L., Miadlikowska J., Lutzoni F., Kraepiel A.M.L., Bellenger J.P (2017) Biological nitrogen fixation by alternative nitrogenases in boreal cyanolichens: importance of molybdenum availability and implications for current biological nitrogen fixation estimates. *New Phytologist* 213:680-689 DOI: 10.1111/nph.14166
- 7) **Zhang X.**, McRose D., Darnajoux R., Bellenger J.P., Morel F.M.M., and Kraepiel A.M.L. (2016) Alternative nitrogenase activity in the environment and nitrogen cycle implications. *Biogeochemistry* 127:189-198. DOI: 10.1007/s10533-016-0188-6
- 8) Baars O, **Zhang X.**, Morel F.M.M., and Seyedsayamdost M. (2016) The siderophore metabolome of *Azotobacter vinelandii*. *Applied and Environmental Microbiology* 82(1): 27-39. DOI: 10.1128/AEM.036160-15
- 9) **Zhang X.**, Sigman, D.M., Morel F.M.M., and Kraepiel A.M.L. (2014) Nitrogen isotope fractionation by alternative nitrogenases and past ocean anoxia. *Proceedings of the National Academy of Sciences USA* 111(13):4782-4787. DOI: 10.1073/pnas.1402976111
- 10) Bellenger J.P., Xu Y., **Zhang X.**, Morel F.M.M., and Kraepiel A.M.L. (2014) Possible contribution of alternative nitrogenases to nitrogen fixation by symbiotic N₂-fixing bacteria in soils. *Soil Biology and Biochemistry* 69(0):413-420. DOI:10.1016/j.soilbio.2013.11.015
- 11) Rosenthal A.Z.⁺, **Zhang X.**⁺, et al. (2013) Localizing transcripts to single cells suggests an important role of uncultured deltaproteobacteria in the termite gut hydrogen economy. *Proceedings of the National Academy of Sciences USA*, 110 (40): 16163-16168 ⁺equal contributors DOI: 10.1073/pnas.1307876110
- 12) Matson E.G., Rosenthal A.Z., **Zhang X.**, and Leadbetter J.R. (2013) Genome-wide effects of selenium and translational uncoupling on transcription in the termite gut symbiont *Treponema primitia*. *mBio* 4(6). DOI: 10.1128/mBio.00869-13
- 13) **Zhang X.**, and Leadbetter J.R. (2012) Evidence for cascades of perturbation and adaptation in the metabolic genes of higher termite gut symbionts. *mBio* 3(4): e00223-12 DOI: 10.1128/mBio.00223-12
- 14) **Zhang X.**, Matson E.G., and Leadbetter J.R. (2011) Genes for selenium dependent and independent formate dehydrogenase in the gut microbial communities of 3 lower, wood-feeding termites and a wood-feeding roach. *Environmental Microbiology* 13(2): 307-323. DOI: 10.1111/j.1462-2920.2010.02330.x
- 15) Matson E.G., **Zhang X.**, and Leadbetter J.R. (2010) Selenium controls transcription of paralogous formate dehydrogenase genes in the termite gut acetogen, *Treponema primitia*. *Environmental Microbiology* 12: 2245-2258. DOI: 10.1111/j.1462-2920.2010.02188.x
- 16) **Zhang X.**, Gillespie A. L., and Sessions A.L. (2009) Large D/H variations in bacterial lipids reflect central metabolic pathways. *Proceedings of the National Academy of Sciences USA* 106:12580-12586. (PNAS Feature article, Journal Cover, Article commentary) DOI: 10.1073/pnas.0903030106

- 17) Warnecke F., Luginbühl P., Ivanova N., Ghassemian M., ..., **Zhang X.**, *et al.* (2007) Metagenomic and functional analysis of hindgut microbiota of a wood-feeding higher termite. *Nature* 450: 560-565. DOI: 10.1038/nature06269
- 18) Vadas T.M., **Zhang X.**, Curran A.M., and Ahner B.A. (2007) Fate of DTPA, EDTA and EDDS in hydroponic media and effects on plant mineral nutrition. *Journal of Plant Nutrition* 30:1229-1246. DOI: 10.1080/01904160701555119

PUBLISHED ABSTRACTS AND POSTER PRESENTATIONS (+ presenter, * undergrad, ** grad. student, *** post-doc)

- 1) Luxem K. ***, Kraepiel A.M.L., Chiu C.*, **Zhang X.** (2018) Use of alternative V-nitrogenase for redox homeostasis in *Rhodopseudomonas palustris*. (Talk, Goldschmidt, Boston)
- 2) Han E. **, Maloney A. ***, Kopf S.H., **Zhang X.** + (2018) Active site constraints on nitrogen stable isotope fractionation by Mo- dependent nitrogenase (Poster, Goldschmidt, Boston)
- 3) Darnajoux R. ****, Renaudin M., Magain N., Miadlikowska J., Lutzoni F., **Zhang X.** Bellenger J.P. (2018) Molybdenum availability controls vanadium nitrogenase activity in boreal forest cyanolichens. (Poster, 13th European Nitrogen Fixation Conference, Stockholm, Sweden)
- 4) Darnajoux R. ****, Renaudin M., Magain N., Miadlikowska J., Lutzoni F., **Zhang X.** Bellenger J.P. (2018) Molybdenum availability controls vanadium nitrogenase activity in boreal forest cyanolichens. (Talk, ISME, Leipzig, Germany)
- 5) Wilmoth J. ****, Schaefer J.K., Schlesinger D., Shoemaker J., Myneni S., **Zhang X.** (2018) The methane paradox in peat systems is linked to redox transitions (Talk, Goldschmidt, Boston)
- 6) **Zhang X.** + (2017) A multi-windowed view of nitrogen fixation in the lab and field (keynote session-Tracing Biogeochemical Cycles From Enzyme To Ecosystem, Goldschmidt, Paris, France)
- 7) **Zhang X.** + (2017) Isotopic insights on nitrogen fixation in the lab and field (1st Geobiology Society Conference, Banff, Canada)
- 8) Bellenger JP⁺, Darnajoux R., **Zhang X.**, Kraepiel A., McRose D., Miadlikowska J., Lutzoni F. (2017) Contribution of alternative nitrogenases to nitrogen fixation in cyanolichens implications for our understanding of high latitude N cycling and cyanolichen symbiosis. (Talk, Future Arctic Workshop: Arctic Bryophytes and Lichens, Foret Montmorency, Canada)
- 9) Luxem K. ***, Chiu C., Kraepiel A.M.L., **Zhang X.** (2017) A role for the alternative V-nitrogenase in redox homeostasis. (Talk, Northeast Geobiology Symposium, University of Connecticut, USA)
- 10) Darnajoux, R. +, **Zhang, X.**, McRose, D., Miadlikowska, J., Kraepiel, A., Lutzoni, F., Bellenger, J.-P. (2017) “A glimpse at the lichen symbiosis; from metal homeostasis to ecosystems function.” (Talk, Northeast Geobiology Symposium, University of Connecticut)
- 11) Lee A.*, Kopf S., **Zhang X.** + (2016) Iron availability influences ¹⁵N-isotope fractionation during nitrogen fixation by aerobic chemoheterotroph *Azotobacter vinelandii* (Poster, AGU annual meeting, San Francisco)
- 12) Sessions A.L⁺, Wijker R., Osburn M., **Zhang X.**, Niepke T. (2016) Hydrogen isotope

- fractionation in microbial metabolism. (Gordon Conference in Geobiology, Galveston, TX).
- 13) **Zhang X.** †, McRose D., Darnajoux R., Bellenger J.P., Morel F.M.M., and Kraepiel A.M.L. (2015) Forging links between the cycles of nitrogen and trace metals using stable isotope biomarkers of nitrogenase metalloenzymes (Poster, 19th International Nitrogen Fixation Conference, Asilomar, CA)
 - 14) **Zhang X.** †, McRose D., Darnajoux R., Bellenger J.P., Morel F.M.M., and Kraepiel A.M.L. (2015) Coupled Biogeochemistry of Nitrogen and Trace Metals: Isotopic Acetylene Reduction Assay (ISARA) Indicates Significant Alternative Nitrogenase Usage in the Environment. (Poster, Carbon Mitigation Initiative Annual Meeting, Princeton, NJ).
 - 15) **Zhang X.** †, McRose D., Darnajoux R., Bellenger J.P., Morel F.M.M., and Kraepiel A.M.L. (2015) Coupled Biogeochemistry of Nitrogen and Trace Metals: Isotopic Acetylene Reduction Assay (ISARA) Indicates Significant Alternative Nitrogenase Usage in the Environment. (Poster, American Society of Microbiology Annual Meeting, New Orleans, Louisiana).
 - 16) McRose D. †, **Zhang X.**, Darnajoux R., Bellenger J.P., Morel F.M.M., and Kraepiel A.M.L. (2015) Diverse Assemblages of Alternative Nitrogenases are Present and Active in Coastal Sediments. (Poster, American Society of Microbiology Annual Meeting, New Orleans, Louisiana)
 - 17) **Zhang X.** †, McRose D., Darnajoux R., Bellenger J.P., Morel F.M.M., and Kraepiel A.M.L. (2015) Isotopic Acetylene Reduction Assay (ISARA) Indicates Significant Alternative Nitrogenase Usage in the Environment. (Poster, Northeastern Geobiology Conference, Princeton, NJ.)
 - 18) **Zhang X.** †, Sigman D.M., Morel F.M.M., and Kraepiel A.M.L. (2013) Isotope fractionation by alternative nitrogenases and past ocean anoxia. (Poster, American Geophysical Union, San Francisco, CA.)
 - 19) **Zhang X.** †, Sigman D.M., Morel F.M.M., and Kraepiel A.M.L.* (2013) Isotope fractionation by alternative nitrogenases and past ocean anoxia. (Talk, Goldschmidt Conference, Florence, Italy)
 - 20) **Zhang, X.**, Sessions, A.L. †, Gillespie, A. L. (2008) Huge variations in D/H fractionation associated with microbial heterotrophy. (Poster, 18th V.M. Goldschmidt Conference, University of British Columbia, Vancouver, Canada.)
 - 21) **Zhang X.** †, Matson, E.G., and Leadbetter, J.R. (2008) Formate dehydrogenase diversity in the homoacetogenic spirochete *Treponema primitia* and in termite hindgut microbial communities suggests their adaptation to a changing selenium environment. (Poster, 2nd Conference on Beneficial Microbes, American Society for Microbiology, San Diego, USA.)
 - 22) **Zhang X.** †, Matson, E.G., and Leadbetter, J.R. (2007) Formate dehydrogenase diversity in the homoacetogenic spirochete *Treponema primitia* and in