CURRICULUM VITAE

Shuang Zhang

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Department of Oceanography at Texas A&M University
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EDUCATION

Yale University — New Haven, CT, USA
Ph.D., Department of Earth & Planetary Sciences — Aug 2011 – Jul 2017

Peking University — Beijing, China
B.S. with honor, School of Earth and Space Sciences — Sep 2007 – Jul 2011

RESEARCH POSITIONS

Assistant Professor — College Station, TX, USA
- Department of Oceanography, Texas A&M University — Jan 2021 – present

Postdoctoral Fellow — Washington, DC, USA
- [Mentor: Robert Hazen] — Jul 2019 – Dec 2020
- Earth & Planets Laboratory, Carnegie Institution for Science

Postdoctoral Associate — New Haven, CT, USA
- [Mentor: Noah Planavsky] — Jul 2017 – Jul 2019
- Department of Earth & Planetary Sciences, Yale University

PUBLICATIONS

Submitted, In Review or In Revision (*denotes student/postdoc publications)

Wang, W., Zhang, F., **Zhang, S.**, Cui, Y., Zheng, Q., Zhang, Y., Yuan, D., Zhang, H., Xu, Y., Shen, S. Ecosystem responses of two Permian biocrises modulated by CO_2 emission rates. *Earth and Planetary Science Letters*.

Zhang, S., Planavsky, N., Katchinoff, J., Raymond, P., Kanzaki, Y., Reershemius, T., Reinhard, C. Insights from river chemistry into carbon capture potential through surficial enhanced rock weathering. *Limnology and Oceanography*.

Reinhard, C., Planavsky, N., **Zhang, S.** Crustal differentiation, phosphorus cycling, and oxygen-based biosignatures on Earth-like planets. *Journal of the Geological Society*.

Zhang, S., Planavsky, N., Hartmann, J., Amatulli, G. A case study in modeling silicate chemical weathering using machine learning. *Global Biogeochemical Cycles*.

Jiang, L., Shen, A., Qiao, Z., Hu, A., Zhang, H., Wan, B., **Zhang, S.**, Zhao, M. Tectonic Driven Fluids Mixing and Hypogene Cavern Reservoir Formation in Carbonates. *AAPG Bulletin*.

Published or In Press (peer reviewed)

24. Rattanasriampaipong, R., Zhang, Y., Pearson, A., Hedlund, B., **Zhang**, S. 2022. Archaeal lipids trace ecology and evolution of marine ammonia-oxidizing archaea. PNAS. DOI: 10.1073/pnas.2123193119.

23. Kanzaki, Y., **Zhang, S.**, Planavsky, N., Reinhard, C. 2022. Soil Cycles of Elements simulator for Predicting TERrestrial regulation of greenhouse gases: SCEPTER v0.9. Geoscientific Model Development (GMD). DOI: 10.5194/gmd-15-4959-2022.

22. Isson, T., **Zhang, S.**, Lau, K., Rauzi, S., Tosca, N., Penman, D., Planavsky, N. 2022. Marine siliceous ecosystem decline led to sustained anomalous Early Triassic warmth. *Nature Communications.* DOI: 10.1038/s41467-022-31128-3.

21. Planavsky, N., Fakhraee, M., Bolton, E., Reinhard, C., Isson, T., **Zhang, S.**, Mills, B. 2022. On carbon burial and net primary production through Earth's history. *American Journal of Science.* DOI: 10.2475/03.2022.01.

20. Chen, J., Montañez, I.P., **Zhang, S.**, Isson, T.T., Macarewich, S.I., Planavsky, N.J., Zhang, F., Rauzi, S., Daviau, K., Yao, L., Qi, Y., Wang, Y., Fan, J., Poulsen, C.J., Anbar, A.D., Shen, S., Wang, X., 2022. Marine anoxia linked to abrupt global warming during Earth's penultimate icehouse. *PNAS*. DOI: 10.1073/pnas.2115231119.

19. He, Y., Zhou, Y., Wen, T., **Zhang, S.**, Huang, F., Zou, X., Ma, X., Zhu, Y.. 2022. A review of machine learning in geochemistry and cosmochemistry: Method improvements and applications. *Applied Geochemistry*. DOI: https://doi.org/10.1016/j.apgeochem.2022.105273.

18. Shen, J., Yin, R., **Zhang, S.**, Algeo, T., Bottjer, D., Yu, J., Planavsky, N., Xu, G., Penman, D., Wang, Y., Li, L., Deng, S., Feng, Q., Huang, J. 2022. Intensified continental chemical weathering and global carbon cycle perturbation linked to volcanism during the Triassic-Jurassic transition. *Nature Communications*. DOI: 10.1038/s41467-022-27965-x.

17. Li, F., Penman, D., Planavsky, N., Knudsen, A., Zhao, M., Wang, X., Isson, T., Huang, K., Wei, G., **Zhang, S.**, Shen, J., Zhu, X., Shen, B. Reverse weathering amplifies post-Snowball atmospheric carbon dioxide levels. 2021. *Precambrian Research*. DOI: 10.1016/j.precamres.2021.106279.

16. Caves Rugenstein, J., Ibarra, D., **Zhang, S.**, Planavsky, N., von Blanckenburg, F. 2021. Isotope mass-balance constraints preclude that mafic weathering drove Neogene cooling. *PNAS*. DOI: 10.1073/pnas.2026345118.

15. Boujibar, A., Howell, S., **Zhang, S.**, Hystad, G., Prabhu, A., Liu, N., Stephan, T., Narkar, S., Eleish, A., Morrison, S.M., Hazen, R.M., Nittler, L.R. 2021. Cluster Analysis of Presolar Silicon Carbide Grains: Evaluation of Their Classification and Astrophysical Implications. *The Astrophysical Journal Letters*. DOI: 10.3847/2041-8213/abd102.

14. Stewart, J.A., Christopher, S.J., Kucklick, J.R., Bordier, L., Chalk, T.B., Dapoigny, A., Douville, E., Foster, G.L., Gray, W.R., Greenop, R., Gutjahr, M., Hemsing, F., Henehan, M.J., Holdship, P., Hsieh, Y.-T., Kolevica, A., Lin, Y.-P., Mawbey, E.M., Rae, J.W.B., Robinson, L.F., Shuttleworth, R., You, C.-F., **Zhang, S.**, Day, R.D. 2021. NIST RM 8301 Boron Isotopes in Marine Carbonate (Simulated Coral and Foraminifera Solutions): Inter-laboratory δ11B and Trace Element Ratio Value Assignment. *Geostandards and Geoanalytical Research*. DOI: 10.1111/ggr.12363.

13. Zhao, M., **Zhang, S.**, Tarhan, L., Reinhard, C., Planavsky, N. 2020. The role of calcium in regulating marine phosphorus burial and atmospheric oxygenation. *Nature Communications*. DOI: 10.1038/s41467-020-15673-3.

12. Isson, T., Planavsky, N., Coogan, L., Stewart, E., Ague, J., Bolton, E., **Zhang, S.**, McKenzie, R., Kump, L. 2020. Evolution of the global carbon cycle and climate regulation on Earth. *Global Biogeochemical Cycles*. DOI: 10.1029/2018GB006061.

11. **Zhang, S.** and Planavsky, N. 2020. Revisiting groundwater fluxes to the ocean with implications for the carbon cycle. *Geology*. DOI: 10.1130/G46408.1.

10. Henehan, S., Ridgwell, A., Thomas, E., **Zhang, S.**, Alegret, L., Schmidt, D., Rae, J., Witts, J., Landman, N., Greene, S., Huber, B., Super, J., Planavsky, N., Hull, P. 2019. Rapid ocean acidification and protracted Earth system recovery followed the end-Cretaceous Chicxulub impact. *PNAS*. DOI: 10.1073/pnas.1905989116.

9. Li, Y., McCoy-West, A., **Zhang, S.**, Selby, D., Burton, K., Horan, K. 2019. Controlling mechanisms for molybdenum isotope fractionation in porphyry deposits: The Qulong example. *Economic Geology*. DOI: 10.5382/econgeo.4653.

8. **Zhang, S.** and Planavsky, N. 2019. The silicate weathering feedback in the context of ophiolite emplacement: Insights from an inverse model of global weathering proxies. *American Journal of Science*. DOI: 10.2475/02.2019.01.

7. Li, Y., **Zhang, S.**, Hobbs, R., Caiado, C., Sproson, A., Selby, D., Rooney, A. 2019. Monte Carlo sampling for error propagation in linear regression and applications in isochron geochronology. *Science Bulletin*. DOI: 10.1016/j.scib.2018.12.019.

6. Krause, J., Mills, B., **Zhang, S.**, Planavsky, N., Lenton, T., Poulton, S. 2018. Stepwise oxygenation of the Paleozoic atmosphere. *Nature Communications*. DOI: 10.1038/s41467-018-06383-y.

5. **Zhang, S.**, Planavsky, N., Krause, J., Mills, B., Bolton, E. 2018. Model based Paleozoic atmospheric oxygen estimates: a revisit to GEOCARBSULF. *American Journal of Science*. DOI: 10.2475/05.2018.05.

4. **Zhang, S.**, Ague, J., Vitale Brovarone, A. 2018. Degassing of organic carbon during regional metamorphism of pelites, Wepawaug Schist, Connecticut, USA. *Chemical Geology*. DOI: 10.1016/j.chemgeo.2018.05.003.

3. Cole, D., **Zhang, S.**, Planavsky, N. 2017. A new estimate of detrital redox-sensitive metal concentrations and variability in marine sediments. *Geochimica et Cosmochimica Acta*. DOI: 10.1016/j.gca.2017.08.004.

2. **Zhang, S.**, Henehan, M., Hull, P., Reid, R., Hardisty, D., Hood, A., Planavsky, N. 2017. Investigating controls on boron isotope ratios in shallow marine carbonates. *Earth and Planetary Science Letters*. DOI: 10.1016/j.epsl.2016.10.059.

1. Planavsky, N., Cole, D., Reinhard, C., Diamond, C., Love, G., Luo, G., **Zhang, S.**, Konhauser, K., Lyons, T. 2016. No evidence for high atmospheric oxygen levels 1,400 million years ago. *PNAS*. DOI: 10.1073/pnas.1601925113.

THESES AND REPORTS

Zhang, S. 2017. Case studies on tracking and modeling the global carbon cycle (Doctoral dissertation, Yale University).

Wang, Z., Qiu, L., **Zhang, S.**, et al. 2014. Integrated experimental and modeling studies of mineral carbonation as a mechanism for permanent carbon sequestration in mafic/ultramafic rocks (DOE Technical Report).

Zhang, S. 2011. Petrologic characteristics and genesis of granitic veins in TTG gneiss from Hengshan Complex in Shanxi Province, China (Bachelor thesis, Peking University).

SELECTED CONFERENCE PRESENTATIONS

Zhang, S., Planavsky, N., Katchinoff, J., Raymond, P., Kanzaki, Y., Reershemius, T., Reinhard, C. Insights from river chemistry into carbon capture potential through surficial enhanced rock weathering. GSA Conference, Portland, OR, USA, Oct 2021

Boujibar, A., **Zhang, S.**, Howell, S., Hystad, G., Prab, A., Narkar, S., Eleish, A., Morrison, S., Liu, N., Stephan, T., Alexander, C., Hazen, R., Nittler, L. Assessing the Classification of

Presolar Silicon Carbide Grains Using Cluster Analysis. Goldschmidt Conference, Virtual. Jun 2020

Zhang, S., Morrison, S., Prabhu, A., Ma, C., Huang, F., Gregory, D., Large, R., Hazen, R. Natural clustering of pyrite with implications for its formational environment. AGU Conference, San Francisco, CA, USA. Dec 2019.

Zhang, S., Morrison, S., Prabhu, A., Ma, C., Huang, F., Gregory, D., Large, R., Hazen, R. Understanding modes of pyrite formation using natural clustering. Deep Carbon Observatory, Washington, DC, USA. Oct 2019.

Zhang, S., Planavsky, N. Ground-truthing silicate chemical weathering using machine learning. Goldschmidt Conference, Barcelona, Spain. Aug 2019.

Zhang, S., Planavsky, N. Predicting silicate weathering rates across the continental United States. AGU Conference, Washington, DC, USA. Dec 2018.

Zhang, S., Planavsky, N. Prediction of atmospheric oxygen level during the Paleozoic using GEOCARBSULF, Northeastern Geobiology Symposium, Storrs, CT, USA. May 2017.

Henehan, M., Ridgwell, A., Thomas, E., **Zhang, S.**, Planavsky, N., Alegret, L., Schmidt, D., Rae, J., Foster, G., Huber, B., Hull, P. 2016. How strange was the Strangelove Ocean? New insights from Boron Isotopes. AGU Conference, San Francisco, CA, USA. Dec 2016.

Zhang, S., Henehan, M., Hull, P., Reid, R., Hardisty, D., Hood, A., Planavsky, N. Do boron isotopes in shallow marine carbonate record marine pH? Goldschmidt Conference, Yokohama, Japan. Jun 2016.

Cole, D.B., **Zhang, S**., Planavsky, N. Untangling detrital and authigenic signals of redox sensitive proxies. Goldschmidt Conference, Yokohama, Japan. Jun 2016.

Zhang, S., Qiu, L., Wang, Z., Karato, S., Johnson, K. T., Ague, J., Oristaglio, M. L., Bolton, E. W., Bercovici, D. Experimental study of the carbonation potential of basalts. YCEI Fifth Annual Conference, New Haven, CT, USA. Dec 2014.

Zhang, S., Wang, Z., Qiu, L., Karato, S., Johnson, K. T., Ague, J., Oristaglio, M. L., Bolton, E. W., Bercovici, D. Experimental study of the reaction kinetics between CO_2-bearing solution and picrite cubes. AGU Conference, San Francisco, CA, USA. Dec 2013.

GEOLOGICAL APPLICATION DEVELOPMENT

Created and maintained the Isochron shiny app (https://isochron-beta1.shinyapps.io/isochron/), which integrates the Monte Carlo analysis and greatly simplifies the workflow of geological dating using various radiogenic isotope systems.

GRANTS

TAMIDS Career Initiation Fellow **2022**

Awarded **$10,000** to engage with TAMIDS activities, programs, or broader missions
[PI: Shuang Zhang]

GeoDean's Disciplinary/Interdisciplinary Research Initiative Grant **2021**

Awarded **$6,000** to conduct preliminary studies towards concept development to prepare competitive proposals for external funding sources.
[PI: Shuang Zhang, Co-Is: Ping Chang, Giuseppe Amatulli, Tao Wen]

TAMIDS Course Development Grant **2021**

Awarded **$15,000** to develop new courses in Data Science (including Artificial Intelligence and Machine Learning within the program scope).
[PI: Shuang Zhang, Co-I: Darren Henrichs]

AWARDS AND HONORS

- Hutchison Fund Travel Award **$2,000**
  One of the 15 awardees for attending the 2020 IGC meeting IUGS, 2019
- Karl Turekian Prize **$1,000**
  Outstanding Ph.D. student in geochemistry Yale University, 2017
- Conference Travel Fellowship **$815**
  Awarded for attending scientific conferences Yale University, 2016
- Research Funding from Yale Institute of Biospheric Studies Yale University, 2014
- Yale University Fellowship Yale University, 2011
- Outstanding Undergraduate of Peking University Peking University, 2011
- Starlight International Scholarship Peking University, 2010
- 3rd Prize in Beijing Regional Physics Contest Peking University, 2009
- Starlight International Scholarship Peking University, 2008
- Tung OOCL Scholarship Peking University, 2008
- Canon Special Scholarship Peking University, 2007

PROFESSIONAL ACTIVITIES AND OUTREACH

Journal Referee

Science / Nature Geoscience / Nature Communications / Earth and Planetary Science Letters / Geochimica et Cosmochimica Acta / Water Resources Research / Geophysical Research Letters / Communications Earth & Environment / Global Biogeochemical Cycles / Paleoceanography /

Paleoceanography and Paleoclimatology / Palaeogeography, Palaeoclimatology, Palaeoecology / Sedimentary Geology / Geoscience Data Journal / American Journal of Science / American Mineralogist / Journal of the American Water Resources Association / Earth System Dynamics (ESD) / PLOS climate

Grant Referee

NSF external reviewer

Professional Development

- Leader in the data science workshop hosted by Carnegie Institution for Science featuring hands-on clustering analysis — Washington, DC, USA, Aug 2020
- Participant in deep-time data science workshop hosted by University of Idaho featuring lighting talks and machine learning training — Moscow, ID, USA, May 2019
- Participant in computational workshops hosted by Yale Center for Research Computing, including version control with Git, scripting with Python, writing efficient R code, data analysis with Python, practical HPC, geo-computation and environmental analysis, scalable machine learning in the AWS cloud, etc. — New Haven, CT, USA, 2012 – 2017
- Full-stack web developer for United Nations Global Compact: independently designed and created a fully responsive website — New Haven, CT, USA, Nov 2014 – Feb 2015

Professional Affiliations

- American Geophysical Union (AGU) — 2012 – Present
- Geochemical Society — 2015 – Present

Field Trips

- Organizer of the Rhode Island field trip — Sep 2012
- Participant in the field trip in southern and western Connecticut — Oct 2011

Public Service

- Session convener and co-chair for 2021 GSA conference: (T173) Machine Learning for Advancing Data Analysis Toolkit in Geoscience, Portland, OR, USA, Oct 2021
- Invited instructor on Cluster analysis and its application in geochemistry. “Earth Science meets Data Science workshop”, Goldschmidt Conference. Virtual. Jun 2020.
- Judge for Outstanding Student Presentation Award (OSPA) for AGU conference. San Francisco, CA, USA, Dec 2019
- Session convener and chair for 2019 AGU conference: (EP23D) Application of data and machine learning in Earth science, San Francisco, CA, USA, Dec 2019
- Deputy leader of Young Volunteers Association in School of Earth and Space Sciences, Peking University, Beijing, 2008 – 2010

- Volunteer of teaching science at Ming Yuan elementary school, Beijing, 2008 – 2010
- Volunteer of teaching English to middle school students, Weifang, Shandong, 2008 – 2009

TEACHING EXPERIENCE

- Applied Data Science in Geosciences (TAMU) — Sp 2022
- Python for Geosciences (TAMU) — Fa 2021; Sp 2022
- Introduction to GRASS GIS: Teaching assistant — Fa 2018
- G & G 625 Oceanography: Guest lecturer — Fa 2018
- G & G 614 Biogeochemical Cycles Through Time: Guest lecturer — Fa 2018
- G & G 775 Lithosphere and Surface Processes: Guest lecturer — Sp 2018
- G & G 275 Renewable Energy: Office hours, grading weekly problem sets and exams for 35 students — Fa 2016
- G & G 275 Renewable Energy: Office hours, grading weekly problem sets and exams for 35 students — Sp 2016
- ENAS 747 Applied Numerical Methods I: Office hours and debugging weekly programs for 20 students — Fa 2014
- G & G 274 Fossil Fuels & Energy Transitions: Office hours, grading problem sets and final essays for 75 students — Fa 2013
- G & G 100 Natural Disasters: Grading weekly problem sets for 20 students — Fa 2011

MENTORING EXPERIENCE

- Committee member for graduates from Syracuse University and University of Waikato — 2021-
- Committee member for undergraduate Thomas Button (TAMU) — 2021-2022
- Mentoring one undergraduate from Maine Maritime Academy in the NSF-funded REU program (**Best Presentation Award**) — 2021 summer
- Mentoring one undergraduate from Washington College on unsupervised machine learning — 2019 – 2020
- Mentoring one graduate student at Yale on numerical modeling of the global carbon cycle — 2018 – 2021
- Mentored one graduate student at Yale on boron isotope measurements using MC-ICP-MS — 2018 – 2019
- Mentored three graduate students at Yale on computer languages such as Python, R, and MATLAB — 2015 – 2019
- Mentored two undergraduate students at Yale for lab work — 2013 – 2015
- Supervised one undergraduate at Yale on his undergraduate thesis about carbon sequestration — 2013