

# Jeff R. Havig

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 Earth and Environmental Sciences      Phone: 509-637-6375  
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## Professional Preparation:

Arizona State University      Geological Sciences (Geochemistry) Ph.D. [2009]  
 Dissertation title: *Geochemistry of hydrothermal biofilms: Compositions of biofilms in a siliceous sinter-depositing hot spring.*  
 Washington State University      Geology (Groundwater)      M.Sc. [2002]  
 Thesis title: *Effects of perturbation on nutrient pools and loss from an experimental forest mesocosm.*  
 Washington State University      Chemistry (Environmental Chem.)      B.Sc. [1999]

## Appointments:

University of Minnesota	Contract Assistant Professor	Sept. 2017-present
University of Cincinnati	Adjunct Faculty	Aug. 2015-May 2017
University of Cincinnati	Postdoctoral Researcher	Aug. 2015-Aug. 2016
University of Cincinnati	Visiting Scientist	Mar. 2015-Aug. 2015
Pennsylvania State University	PSARC Postdoctoral Researcher	Jul. 2012-Jan. 2015
Arizona State University	Postdoctoral Research Faculty	Jun.2009-Dec. 2011

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## Publications: (listed in chronological order, \*denotes student led paper)

### *In review*

**Havig, J. R.**, Kuether, J., Gangidine, A., Schroeder, S., and Hamilton, T. L. (2020) Hot Spring Microbial Community Elemental Composition: Hot Spring and Soil Inputs, and the Transition from Biocumulus to Siliceous Sinter. *Astrobiology* (in revision)

\*Djokic, T., Van Kranendonk, M. J., Campbell, K. A., **Havig, J. R.**, Walter, M. R., and Guido, D. M. (2020) A reconstructed subaerial hot spring field in the ~3.5 billion-year-old Dresser Formation, North Pole Dome, Pilbara Craton, Western Australia. *Astrobiology* (in revision)

Grettenberger, C., **Havig, J. R.**, and Hamilton, T. L. (2020) Co-occurrence of multiple Ferrovum species at acid mine drainage sites suggests intra-genus metabolic diversity limits competition. *BMC Biology* (in revision).

**Published**

\*Gangidine, A., **Havig, J. R.**, Hannon, J. S., and Czaja, A. D. (2020) A wet-dry cycling hot spring simulation chamber. *Life* 10(1), 3. DOI: 10.3390/life10010003

Hamilton, T. L., Corman, J., **Havig, J. R.** (2019) Carbon and nitrogen recycling during cyanoHABs in dreissenid-invaded and non-invaded US midwestern lakes and reservoirs. *Hydrobiologia*. <https://doi.org/10.1007/s10750-019-04157-1>

\*Gangidine, A., **Havig, J. R.**, Fike, D. A., Jones, C., Hamilton, T. L., and Czaja, A. D. (2019) Trace element concentrations in hydrothermal silica deposits as a potential biosignature. *Astrobiology*. DOI: 10.1089/ast.2018.1994

Hamilton, T. L., Bennett, A. C., Murugapiran, S. K., and **Havig, J. R.** (2019) Anoxygenic phototrophs span geochemical gradients and diverse morphologies in terrestrial geothermal springs. *mSystems* 4:e00498-19. <https://doi.org/10.1128/mSystems.00498-19>.

**Havig, J. R.** and Hamilton, T. L. (2019) Productivity and Community Composition of Low Biomass/High Silica Precipitation Hot Springs: A Possible Window to Earth's Early Biosphere? *Life* 9(3), 64. DOI: 10.3390/life9030064

**Havig, J. R.** and Hamilton, T. L. (2019) Hypolithic photosynthesis in hydrothermal areas and implications for cryptic oxygen oases on Archean continental surfaces. *Frontiers in Earth Sciences, Biogeoscience*. DOI: 10.3389/feart.2019.00015

**Havig, J. R.**, and Hamilton, T. L. (2019) Snow algae drive productivity and weathering at volcanic rock-hosted glaciers. *Geochimica et Cosmochimica Acta* 247, 220-242. DOI: 10.1016/j.gca.2018.12.024

Rutledge, A. M., Horgan, B. H. N., **Havig, J. R.**, Rampe, E. B., Scudder, N. A., and Hamilton, T. L. (2018) Silica Dissolution and Precipitation in Glaciated Volcanic Environments, and Implications for Mars. *Geophysical Research Letters* 45. DOI: 10.1029/2018GL078105

\*Milshteyn, D., Damer, B., **Havig, J. R.**, and Deamer, D. (2018) Amphiphilic Compounds Assemble into Membranous Vesicles in Hydrothermal Hot Spring Water but Not in Seawater. *Life* 8(11). DOI: 10.3390/life8020011

Herndon, E. M., **Havig, J. R.**, Singer, D. M., McCormick, M. L., and Kump, L. R. (2018) Manganese and iron geochemistry in sediments underlying a redox-stratified lake. *Geochimica et Cosmochimica Acta* 231: 50-63. DOI: 10.1016/j.gca.2018.04.013

**Havig, J. R.**, McCormick, M. L., Hamilton, T. L., McClure, B. E., Sowers, T., and Kump, L. R. (2018) Water column and sediment carbon stable isotope biogeochemistry

of a redox-stratified lake: Fayetteville Green Lake, N.Y. *ASLO Limnology and Oceanography* 63(2), 570-587. DOI: 10.1002/lno.10649

Hamilton, T. L. and **Havig, J. R.** (2018) Inorganic carbon addition stimulates snow algae primary productivity. *The ISME journal*, 1. DOI:10.1038/s41396-018-0048-6

**Havig, J. R.**, Hamilton, T. L., Bachan, A. V., and Kump, L. R. (2017) Sulfur and carbon isotopic evidence for metabolic pathway evolution and a four-stepped Earth system progression across the Archean and Paleoproterozoic. *Earth-Science Reviews* 174: 1 – 21. DOI: 10.1016/j.earscirev.2017.06.014

**Havig, J. R.**, Grettenberger, C. L., and Hamilton, T. L. (2017) Microbial community composition across a range of acid mine drainage impact and implications for the Neoproterozoic-Paleoproterozoic transition. *JGR Biogeosciences* 122(6): 1404-1422. DOI: 10.1002/2016JG003594

\*Schuler, C. G., **Havig, J. R.**, and Hamilton, T. L. (2017) Hot spring microbial community composition, morphology, and carbon fixation: implications for interpreting the ancient rock record. *Frontiers in Earth Science, Biogeoscience*, 5, 97. DOI: <https://doi.org/10.3389/feart.2017.00097>

Colman, D. R., Poudel, S., Hamilton, T. L., **Havig, J. R.**, Selensky, M. J., Shock, E. L., and Boyd, E. S. (2017) Oxygen and the Evolution of Thermoacidophiles. *The ISME journal* DOI: 10.1038/ismej.2017.162

Hamilton, T. L., and **Havig, J. R.** (2017) Primary productivity of snow algae communities on stratovolcanoes of the Pacific Northwest. *Geobiology* DOI:10.1111/gbi.12219

**Havig, J. R.**, McCormick, M. L., Hamilton, T. L., and Kump, L. R. (2015) The behavior of biologically important trace elements across the oxic/euxinic transition of meromictic Fayetteville Green Lake, New York, USA. *Geochimica et Cosmochimica Acta* 165, 389-406. DOI: 10.1016/j.gca.2015.06.024

Boyd, E.S., Hamilton, T.L., **Havig, J. R.**, Skidmore, M., Shock, E.S. (2014) Chemolithotrophic primary production in a subglacial ecosystem. *Applied and Environ. Microb.* 80: 6146-6132. DOI:10.1128/AEM.01956-14

Hamilton, T. L., Koonce, E., Howells, A., **Havig, J. R.**, Jewell, T., de la Torre, J. R., Peters, J. P., and Boyd, E. S. (2014) Competition for ammonia influences the structure of chemotrophic communities in geothermal springs. *Applied and Environ. Microb.* 80(2), 653-661. DOI: 10.1128/AEM.02577-13

\*Paukert, A. N., Matter, J. M., Kelemen, P. B., Shock, E. L., and **Havig, J. R.** (2012) Reaction path modeling of enhanced in situ CO<sub>2</sub> mineralization for carbon sequestration

in the peridotite of the Samail Ophiolite, Sultanate of Oman. *Chemical Geology* 330-331:86-100. DOI: 10.1016/j.chemgeo.2012.08.013

Boyd, E. S., Fecteau, K. M., **Havig, J. R.**, Shock, E. L., and Peters, J. W. (2012) Modeling the Habitat Range of Phototrophs in Yellowstone National Park: Toward the Development of a Comprehensive Fitness Landscape. *Front. Microbio.* 3:221. DOI: 10.3389/fmicb.2012.00221

Miller-Coleman, R. L., Dodsworth, J. A., Ross, C. A., Shock, E. L., Williams, A. J., Hartnett, H. H., McDonald, A. I., **Havig, J. R.**, and Hedlund, B. P. (2012) Korarchaeota Diversity, Biogeography, and Abundance in Yellowstone and Great Basin Hot Springs and Ecological Niche Modeling Based on Machine Learning. *PLoS ONE* 7(5): e35964. DOI:10.1371/journal.pone.0035964

Swingley, W. D., Meyer-Dombard, D. R., Shock, E. L., Alsop, E. B., Falenski, H. D., **Havig, J. R.**, and Raymond, J. (2012) Coordinating Environmental Genomics and Geochemistry Reveals Metabolic Transitions in a Hot Spring Ecosystem. *PLoS ONE* 7(6): e38108. DOI:10.1371/journal.pone.0038108

\*Loiacono, S. T., Meyer-Dombard, D. R., **Havig, J. R.**, Poret-Peterson, A. T., Hartnett, H. E. and Shock, E. L. (2012), Evidence for High-Temperature *in situ nifH* Transcription in an Alkaline Hot Spring of Lower Geyser Basin, Yellowstone National Park. *Environmental Microbiology*, 14: 1272–1283. DOI: 10.1111/j.1462-2920.2012.02710.x

**Havig, J. R.**, Meyer-Dombard, D. R., Raymond, J., and Shock, E. L. (2011) Merging isotopes and community genomics in a siliceous sinter-depositing hot spring. *JGR-Biogeosciences* 116: G01005. DOI: 10.1029/2010JG001415

\*Cox, A., Shock, E. L., and **Havig, J. R.** (2011) The Transition to Microbial Photosynthesis in Hot Spring Ecosystems. *Chemical Geology* 280(3-4): 344-351. DOI: 10.1016/j.chemgeo.2010.11.022

Meyer-Dombard, D. R., Swingley, W., Raymond, J., **Havig, J.**, Shock, E. L., and Summons, R. E. (2011) Hydrothermal Ecotones and Streamer Biofilm Communities in the Lower Geyser Basin, Yellowstone National Park. *Environmental Microbiology* 13(5): 1-16. DOI: 10.1111/j.1462-2920.2011.02476.x

Boyd, E. S., Lange, R. K., Mitchell, A. C., **Havig, J. R.**, Hamilton, T. L., Shock E. L., Peters, J. W., Skidmore, M. (2011) Diversity, Abundance, and Potential Activity of Nitrifying and Denitrifying Microbial Assemblages in a Subglacial Ecosystem. *Appl. Environ. Microbiol.* July 2011 vol. 77 no. 14 4778-4787. DOI: 10.1128/AEM.00376-11

Keller, C. K., O'Brien, R., **Havig, J. R.**, Smith, J. L., Bormann, B. T., and Wang, D. (2006) Tree Harvest in an Experimental Sand Ecosystem: Plant Effects on Nutrient Dynamics and Solute Generation. *Ecosystems* 9(4): 634-646. DOI: 10.1007/s10021-006-0162-6

Mount, G. H., Rumburg, B., **Havig, J.**, Lamb, B., Westberg, H., Yonge, D., Johnson, K., and Kincaid, R. (2002) Measurement of Atmospheric Ammonia at a Dairy Using Differential Optical Absorption Spectroscopy in the Mid-Ultraviolet. *Atmospheric Environment* 36(11): 1799-1810.

*Pending submissions (manuscripts available upon request)*

**Havig, J. R.**, McCormick, M. L., Hamilton, T. L., and Kump, L. R. (est. Feb., 2020) A dissolved inorganic carbon role in the greatest positive carbon isotope excursion in Earth history. (Target: Nature)

**Havig, J. R.**, Meyer, K., Bachan, A. V., Rybacki, K., Boyer, A., Saltzman, M., House, C., Bekker, A., and Kump, L. R. (est. Mar., 2020) Coming down from a breakup: Extremely positive  $\delta^{13}\text{C}$  carbonate values and supercontinent rifting at circa 2.0 Ga. (Target: Nature Geoscience)

**Havig, J. R.**, Hamilton, T. L., Holloway, J., Boyd, E. S. (est. Mar., 2020) Influence of Subsurface Hydrothermal Processes on the Availability and Use of Fixed Nitrogen for Microbial Metabolism. (Target: PNAS)

Hamilton, A. R., Campbell, K. A., Barker, S., **Havig, J. R.**, Rowland, J. V., Diego, M. G. (est. Feb., 2020) Mineralogy and Geochemistry of High- and Low-Temperature Lithofacies of Siliceous Sinters from Miocene to Modern Geothermal Systems, North Island, New Zealand. (Target: Economic Geology)

Erickson, M., **Havig, J. R.**, and Zeigler, B. (est. Feb., 2020) Very-high arsenic in a glacial aquifer drinking water well: rare – but possible (Target: Environmental Science and Technology)

\*Chen, X., Romaniello, S. J., McCormick, M. L., Sherry, A., **Havig, J. R.**, Zheng, W., and Anbar, A. D. (2020) Anoxic depositional overprinting of  $^{238}\text{U}/^{235}\text{U}$  in calcite: When do carbonates tell black shale tales? (Target: Geology)

**Meeting Abstracts:** (last three years in chronological order, \*denotes student led)

**Havig, J. R.** and Hamilton, T. L. (2019) Integrating geochemical, microbiological, and molecular techniques to characterize and constrain the role of snow algae in local and global biogeochemical cycles. Abstract, presented at 2019 Fall Meeting, AGU, San Francisco, CA, 9-13 Dec.

**Havig, J. R.**, Van Kranendonk, M., Campbell, K., Hamilton, T. L., Djokic, T., Gangidine, A. J., Deamer, D., Damer, B. (2019) 150 years of Yellowstone hot spring research: Biogeosciences and the past, present, and future of ‘warm little ponds.’ Abstract, presented at 2019 Fall Meeting, AGU, San Francisco, CA, 9-13 Dec.

\*Kuether, J. E., Hamilton, T. L., and **Havig, J. R.** (2019) Hydrothermal Hypoliths: A Comparison of Extremophilic Rock-Dwelling Microorganisms with Other Hydrothermal Photo- and Chemotrophic Communities Across Acidic and Alkaline pH Ranges. Abstract, presented at 2019 Fall Meeting, AGU, San Francisco, CA, 9-13 Dec.

\*Gangidine, A. J., **Havig, J. R.**, and Czaja, A. D. (2019) A trace element biosignature for life on early Earth and Mars. NASA Astrobiology Science Conference, Seattle, WA, June 24-28.

\*Penrose, L. K., Campbell, K. A., Rowe, M., Van Kranendonk, M., **Havig, J. R.**, Hamilton, T. L., Sriaporn, C., Handley, K., Nakamura, E. (2019) Terrestrial hot spring analogues for the origin of life? The role of mixing zones in hot springs at Tikitere, Lake Rotokawa, Parariki Stream, and Wai-O-Tapu, New Zealand. NASA Astrobiology Science Conference, Seattle, WA, June 24-28.

**Havig, J. R.**, Kuether, J., Gangidine, A., Schroeder, S., and Hamilton, T. L. (2019) Hot Spring Microbial Community Elemental Composition: Hot Spring and Soil Inputs, and the Transition from Biocumulus to Siliceous Sinter. 2019 Biofilm Symposium, University of Minnesota, Minneapolis, MN, May 16.

**Havig, J. R.** and Hamilton, T. L. (2018) Snow algae drive surface productivity and subglacial weathering at volcanic rock-hosted glaciers in the Pacific Northwest. Abstract, presented at 2018 Snow Algae Meeting, Potsdam, Germany, 15-16 Nov.

\*Bennett, A. C., Murugapiran, S., **Havig, J. R.**, and Hamilton, T. L. (2018) Phototrophic community distribution and morphology along a geothermal stream: Insights into both modern and ancient microbial ecology. Abstract, presented at 2018 Geological Society of America Annual Meeting, Indianapolis, IN, 4-7 Nov.

**Havig, J. R.** and Hamilton, T. L. (2018) Cryptic Oxygen Oases: Hypolithic oxygenic photosynthesis in hydrothermal areas as a model for continental oxidation before the GOE. Abstract, presented at 2018 Goldschmidt Conference, Boston, MA, 13-17 Aug.

\*Chen, X., Romaniello, S., McCormick, M., Sherry, A., **Havig, J.**, and Anbar, A. (2018) Do Manganese Oxides Dominate Transport of Mo Across the Chemocline of Redox-Stratified Lakes? Abstract, presented at 2018 Goldschmidt Conference, Boston, MA, 13-17 Aug.

Hamilton, T. L., Bennet, A., Murugapiran, S., and **Havig, J. R.** (2018) Anoxygenic photosynthesis across temperature and pH space. Abstract, presented at 2018 Goldschmidt Conference, Boston, MA, 13-17 Aug.

**Havig, J. R.** and Hamilton, T. L. (2018) Cryptic Photosynthesis: Hypolithic phototrophic communities as analogs for early Earth and Mars. Abstract, presented at 2018 Australasia Astrobiology Meeting, Rotorua, New Zealand, 25-26 Jun.

**Havig, J. R.** and Hamilton, T. L. (2017) Cryptic oxygen oases: Hypolith photosynthesis in hydrothermal areas and implications for Archean surface oxidation. Abstract, presented at 2017 Fall Meeting, AGU, New Orleans, LA, 11-15 Dec.

Rutledge, A. M., Horgan, B., **Havig, J. R.**, Rampe, E. B., Scudder, N. A., and Hamilton, T. L. (2017) Glacial chemical alteration of Mars-like bedrock. Abstract, presented at 2017 Fall Meeting, AGU, New Orleans, LA, 11-15 Dec.

Hamilton, T. L. and **Havig, J. R.** (2017) Inorganic carbon stimulates snow algae primary productivity. Abstract, presented at 2017 Fall Meeting, AGU, New Orleans, LA, 11-15 Dec.

**Havig, J. R.** and Hamilton, T. L. (2017) Cryptic Photosynthesis: A possible terrestrial analog for early Earth and Mars. NASA Astrobiology Science Conference, Mesa, AZ, April 24-28, 2017.

Rutledge, A. M., Scudder, N. A., **Havig, J. R.**, Horgan, B., Rampe, E. B., and Hamilton, T. L. (2017) Does Melt-driven Silica Cycling Dominate Weathering in Glaciated Volcanic Terrains? Lunar and Planetary Science Conference, Houston, TX, March 20-24, 2017.

**Havig, J. R.**, Hamilton, T. L., McCormick, M., McClure, B., Sowers, T., Wegter, B., and Kump, L.R. (2017) Water Column and Sediment Carbon Isotope Geochemistry of Permanently Redox-Stratified Fayetteville Green Lake, New York, USA. Geological Society of America Joint 52<sup>nd</sup> Northeastern Annual Section/51<sup>st</sup> North-Central Annual Section Meeting, Pittsburgh, PA, March 19-21, 2017.

#### **Research Grants/Awards:**

**The distribution and activity of metabolically diverse anoxygenic phototrophs across geochemical gradients in hydrothermal systems.** NASA Exobiology. Collaborator: J. Havig, PI: T. Hamilton. \$563,000. Jan., 2020 to Dec., 2022.

**Some Liked it Hot: Searching for Early Life in Terrestrial Hot Springs.** Royal Society Te Apārangi Marsden Fund. Invited Collaborator: J. Havig, PI: K. Campbell. \$958,000NZD. 01-10-2018 to 12-31-2020.

**Collapse of the Ancient Maya: Microbiome and Geochemical Analyses of Reservoir Sediments from Tikal Source of Support.** NSF High-Risk Research in Biological Anthropology and Archaeology. Co-I: J. Havig, PI: D. Lentz. \$34,937. 01-01-2017 to 12-31-2018.

**Midwest Geobiology Conference, 2016.** Ohio Space Grant Consortium: SICHOP Grant. PI: J. Havig. \$2,000. Summer, 2016

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**Midwest Geobiology Conference, 2016.** Agouron Institute Award. PI: J. Havig. \$8,000. Spring, 2016

**Geochemical alteration and biological colonization of volcanic substrates: Utilizing the Penn State Steam Plant.** Pennsylvania Space Grant Consortium Seed Grant Award. PI: J. Havig. \$3,400. Spring, 2013.

**Development of an in-lab hydrothermal artificial mesocosm.** Arizona State University Astrobiology Minigrant Award. PI: J. Havig. \$5,172.94. Spring, 2010

**Pending (submitted) Grants:**

**Collaborative Research: Ice Microbes: Alpine Snow Algae and Effects on Glacier Mass Balance.** NSF Frontier Project. PI: T. Hamilton, Co-I: J. Havig. \$2,800,000. Submitted Feb. 3, 2020

**Planned (to be submitted) Grants:**

**How did the largest manganese deposits in the world form after the GOE? Fayetteville Green Lake as a window to the stratified early Paleoproterozoic Ocean.** NSF Geobiology/Low Temperature Geochemistry. PI: J. Havig. \$450,000. Submission target: Mar., 2020.

**Cryptic photosynthesis oases: Hypolith hydrothermal environments as analogs for Archean Earth and Mars terrestrial surfaces.** NSF Geobiology/Low Temperature Geochemistry. PI: J. Havig. \$400,000. Submission target: Feb., 2020.

**Assessing habitability: Differentiating subaqueous versus subaerial hot spring systems.** NASA Exobiology. PI: J. Havig, Science PI: T. Djokic. \$550,000. Submission due: May, 2020.

**Sulfur oases: Unmasking early Earth (and Mars?) metabolic signals using microbial community dynamics coupled to geochemical signatures in modern analogs of ancient hot springs.** NASA Exobiology. PI: J. Havig, Science PI: A. Bosco-Santos. \$700,000. Submission due: May, 2020.

**Special Activities and Service:**

Dept. of Earth and Environmental Sciences faculty representative, University of Minnesota Major/Minor Expo, February 12, 2020.

Geochemistry/Geobiology Outreach Booth, College of Science and Engineering open house, Tate Hall, October 24, 2019.

Department of Earth and Environmental Sciences faculty representative, College of Liberal Arts Research Fair, October 22, 2019.

Reviewer: Graduate Women in Science (GWIS) National Fellowship competition (2019)

Book proposal: **Havig, J. R.** *The first scientific expedition to Yellowstone: Notes and reflections on the 150<sup>th</sup> anniversary of the Hayden Expedition of 1871.*

**Washington State University Press, Pullman, WA.** (accepted proposal, anticipated publication: 2021)



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Undergraduate Studies Committee, Dept. of Earth Sciences, UMN (Fall, 2018-present)  
 Water Resources Science Graduate Program Curriculum Committee (Fall, 2019-present)  
 Soft Rock Lunch Seminar Organizer, Dept. of Earth Sciences, UMN, Fall 2018 through  
 Spring 2020.

Participant: Astrobiology Grand Tour, Pilbara region of Western Australia, July 02-11,  
 2018. Run by the Australian Centre for Astrobiology, hosted by Professor Martin  
 Van Kranendonk, University of New South Wales, Australia.

Co-author, Astrobiology Science Strategy White Paper: *Terrestrial Hot Springs and the  
 Origin of Life: Implications for the Search for Life Beyond Earth*. (Primary  
 author: M. Van Kranendonk). National Academy of Sciences, Engineering, and  
 Medicine, January 8<sup>th</sup>, 2018.

National Science Foundation Spring Grants Conference, Louisville, KY, June 5-6, 2017.  
 Meeting Co-convenor: Midwest Geobiology Conference (5<sup>th</sup> annual), October 15, 2016.  
 Hosted by Dept. of Geology and Dept. of Biological Sciences at UC. Co-  
 convenors: Dr. Aaron Diefendorf, Dr. Andrew Czaja, & Dr. Trinity Hamilton.

Special Research Permit – Active sampling permit allowing collection of samples from  
 hot springs in Yellowstone National Park, Yellowstone Permit Office (#7020). PI.

Reviewer: Chemical Geology, Sedimentary Geology, Frontiers in Terrestrial  
 Microbiology, JGR Biogeosciences

Shake, Rattle, and Rocks (Jan., 2013) – Outreach program through the Department of  
 Geosciences for 5<sup>th</sup> graders in all schools in the greater State College area.

- Co-instructor and curriculum developer, ‘Geochemistry – Life in Extreme  
 Environments’

### Meeting Session Chair

Co-Chair, NASA Astrobiology Science Conference (2017)

- Session Title: Modern and ancient biosignatures and the search for life on Mars.
- Co-chairs: Andrew D. Czaja (Univ. of Cincinnati), Andrew Gangidine (Univ. of  
 Cincinnati), and Scott Perl (NASA-JPL)

Co-Chair, AGU 2015, 2016, 2017 Fall Meetings

- Session Title: (Bio-isotopic) message in a (rock record) bottle: who wrote it, how  
 did it get here, & what does it tell us?
- Co-chairs: Andrew D. Czaja (Univ. of Cincinnati), William Leavitt (Wash.  
 Univ.), and Alexandra Turchin (Univ. of Cambridge)

Co-Chair, AGU 2012 Fall Meeting

- Session Title: Integrating Geochemical and Biological Datasets to Predict the  
 Response of Microbial Communities to a Changing Environment
- Co-chair: Eric S. Boyd (MSU)

Co-Chair, AGU 2011 Fall Meeting

- Session Title: Fun with Isotopes: A lighthearted look at a powerful tool.
- Co-chairs: Laura Wasylenki (IU) and Lynda Williams (ASU)

### Invited Talks

Mineralogical Society of Minnesota, Falcon Heights, MN, May 11, 2019

- Biosignatures: Yellowstone hot springs, 3.5-billion-year-old rocks in Australia,  
 and the search for evidence of past life on Mars.

Minnesota Geological Survey, University of Minnesota, Minneapolis, MN, March 7, 2019

- Tales from Fayetteville Green Lake: Using a permanently stratified lake to interpret geochemical signals from the Paleoproterozoic Ocean.

Boone Pickens School of Geology, Oklahoma State University, Stillwater, OK, February 18, 2019

- Carbon cycling in lakes and reservoirs: Modern impacts and deep time implications.

Geological Society of Minnesota, University of Minnesota, Minneapolis, MN, October 15, 2018

- Biosignatures: Yellowstone hot springs, 3.5-billion-year-old rocks in Australia, and the search for evidence of past life on Mars.

Department of Geoscience, University of Nevada, Las Vegas, Las Vegas, NV, September 19, 2018.

- Snow algae drive surface productivity and subglacial weathering at volcanic rock-hosted glaciers in the Pacific Northwest.

Past Global Changes Symposium – Continental archives of Past Global Changes from Quaternary to Anthropocene, University of Minnesota, Minneapolis, MN, May 24, 2018

- Yellowstone hot spring biofilms: Nitrogen isotopes, nitrogenase, and linking geochemistry to geobiology.

Department of Department of Geological and Atmospheric Sciences Iowa State University, Ames, IA, March 30, 2018

- Ancient mysteries and modern analogs: Exploring the Paleoproterozoic through the geochemistry of meromictic Fayetteville Green Lake, N.Y.

Large Lake Observatory, University of Minnesota, Duluth, Duluth, MN, February 12, 2018

- Fayetteville Green Lake and a potential mechanism for precipitating the largest Mn ore body on Earth following the Great Oxidation Event.

Department of Earth Sciences, University of Minnesota, Minneapolis, MN October 5, 2017.

- Ancient mysteries and modern analogs: Exploring the Archean and Proterozoic through the geochemistry of present-day sites.

Department of Geology, University of Cincinnati, Cincinnati, OH, November 18, 2016.

- Zombie Mines and Brain Biofilms: Acid Mine Drainage Impact and Implications for the Archean-Paleoproterozoic Transition.

Department of Earth Sciences, IUPUI, Indianapolis, IN, April 18, 2016

- Yellowstone hot springs and my hunt for a trace element biosignature.

School for the Environment, University of Massachusetts, Boston, March 27, 2014

- A tale of two hot springs: Exploring geochemical change and biological response in dynamic systems.

Thermal Biology Institute, Montana State University, April 5, 2011

- The Geochemical Composition of Hydrothermal Microbial Biofilms

**Professional Associations:**

Geochemical Society of America/European Geochemical Society  
 Association of Applied Geochemists  
 American Geophysical Union  
 Geobiology Society

**Courses Taught (T)/Teaching Assistant (TA), Developed (D), Semesters (#):****University of Minnesota**

Earth Surface Dynamics (T, 2), Astrobiology Freshman Seminar (T, D, 1),  
 Undergraduate Seminar and Spring Trip (T, 1)

**University of Cincinnati**

Environmental Studies Capstone (T, D, 4)

**Arizona State University**

Introductory Geology Lecture (TA, D, 1), Introductory Geology Lab (TA, 4+),  
 Geochemistry (TA, 1), Geological Hazards Lab (T, D, 2), Astrobiology (TA, 1),  
 Historical Geology (TA, 1), Colloquium (TA, 1)

**Washington State University**

Introductory Geology Lab (TA, D, 3), Organic Chemistry Lab (TA, 1)

**Research Field Sites:**

**Modern hot spring/hydrothermal systems.** Primary focus is on Yellowstone National Park, WY to study the geochemistry and microbiology of hydrothermal systems across a wide range of temperature (up to boiling), pH (from less than 2 to almost 10), and element concentrations (as much as over six orders of magnitude). Sampling trips have been at least once a year since 2003, giving Havig 16 years of experience. Chemical analyses conducted in situ on water samples for redox and temperature sensitive chemical compounds. Samples collected for later laboratory analysis include water, biofilm, sediment, rock, and other contextual samples for determining major elements, trace elements, carbon and nitrogen content and isotopes, oxygen and hydrogen isotopes (water only), as well as molecular analysis of biofilm samples. Work has also been done at multiple hydrothermal areas across western Iceland, and a collaborative effort is being developed to work in multiple hydrothermal areas across the north island of New Zealand, with a first collaborative sampling in the Taupo Volcanic Zone Spring of 2019. Collaborators include researchers from University of Minnesota, University of Minnesota Duluth, University of Cincinnati, University of New South Wales (Australia), University of Auckland (New Zealand), University of Iceland, Northern Arizona University, University of California Santa Cruz, and Indiana University Purdue University at Indianapolis (IUPUI). Active research permit (#7020) maintained through the Yellowstone Research Permitting Office.

**Fayetteville Green Lake, New York.** Research conducted on a meromictic lake in coordination with collaborators on the effects of distinct geochemical gradients formed between the oxygenated upper 20 m, the lower anoxic/euxinic 30 m, and the boundary layer between the two that is inhabited by a photosynthetic purple-sulfur bacterial

community. Collaborators include researchers from University of Minnesota, Hamilton College, Pennsylvania State University, and Indiana University Purdue University at Indianapolis (IUPUI).

**Cyanobacterial bloom impacts on Midwestern US lakes and reservoirs.** Research conducted across Western Ohio from the Cincinnati area through to Lake Erie, and from eastern Indiana through to the Columbus, OH area. Research sites include reservoirs and lakes impacted by cyanobacterial blooms (with a special focus on those with production of the toxin microcystin), and invasive mussel species. Sites sampled include Brookville Reservoir, Crystal Lake, Kaiser Lake, Buckeye Lake, Grand Lake St. Mary's, East Lake, the Maumee River, the Auglaize River, the Sandusky River, Sandusky Bay, and Lake Erie. Currently developing new sites in Minnesota. Collaborators include researchers from University of Minnesota and University of Nebraska.

**Glacial systems of the Pacific Northwest and Western USA.** Geochemical and microbiological research conducted on the ice-liquid water-sediment/rock interface with the goal of better understanding the geochemical environment and inhabitant microbial communities of these actively changing systems. Sample sites include Mt. Adams in Washington, Mt. Hood and North Sister in Oregon, the Beartooth Mountains in Montana, and the Medicine Bow Mountains in Wyoming. Collaborators include researchers at the University of Minnesota, Northern Arizona University, and Purdue University.

**Acid Mine Drainage impacted sites.** Geochemical and microbiological research conducted on springs and streams in the Daniel Boone National Forest that are impacted by historical and recent coal mining activities. Sample sites include the Co-Op mining area, Cabin Branch drainage, and the Wildcat Branch Area. Collaborators include researchers from University of Minnesota and University of California Davis.

**Ancient terrains of the Pilbara, Western Australia.** Archean terrains of the Pilbara including terrestrial hot spring, lacustrine, and marine deposits of the 3.48 Ga Dresser Formation hosting putative microbialites/stromatolites/geyserite. Research focus is on making connections between modern systems in Yellowstone National Park with textures and geochemical signatures found in Dresser Fm. samples. Collaborators include researchers from University of Minnesota, University of New South Wales (Australia), University of Auckland (New Zealand), and University of Cincinnati.

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