

## **ELISABETH (LIBBY) HAUSRATH**

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Department of Geoscience  
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### **EDUCATION**

**The Pennsylvania State University**, University Park, PA 2002 to 2007  
Dual-Title Ph.D. Degree Program in Geosciences and Astrobiology  
NSF Graduate Research Fellow  
NSF-Penn State BRIE Fellow (Penn State Biogeochemical Research Initiative for Education)  
Advisor: Dr. Susan Brantley  
Thesis title: Basalt weathering on Earth and on Mars

**Brown University**, Providence, RI 1996 to 2000  
Sc.B Geology-Chemistry, Honors, Magna Cum Laude

### **TEACHING EXPERIENCE**

**University of Nevada, Las Vegas**, Las Vegas, NV  
Geog 103 Physical Geography of Earth's Environment  
Geol 100 Natural Disasters  
Geol 110 Global Warming  
Geol 330 Introduction to Geochemistry  
Geol 425/625 Principles of Geochemistry  
Geol 478/678 Hydrogeochemistry  
Geol 796 Aqueous Biogeochemistry  
Geol 703 Topics in Advanced Geochemistry

**The Pennsylvania State University**, University Park, PA  
*Teaching Assistant* Geosc 40 (The Sea Around Us)  
*Teaching Assistant* Geosc 413 (Techniques in Environmental Geochemistry)

**Boise State University**, Boise, Idaho  
*Adjunct Faculty* Math 025 (Elementary Algebra)

**Brown University**, Providence, RI  
*Laboratory Teaching Assistant* Chem 21 (Introductory Chemistry)  
*Undergraduate Laboratory Teaching Assistant* Geo 23 (Geochemistry)

### **PROFESSIONAL EXPERIENCE**

**Department of Geoscience, University of Nevada, Las Vegas** 2015-present  
*Associate Professor*

**Department of Geoscience, University of Nevada, Las Vegas** 2009-2015  
*Assistant Professor*

**NASA Postdoctoral Program NASA Johnson Space Center** 2007-2008  
*NASA Postdoctoral Fellow*  
Supervisor: Dr. Douglas Ming

**JOURNAL ARTICLES:**

\* Indicates Hausrath-advised student author # indicates Hausrath-advised postdoctoral author

Hausrath, E.M., Liermann, L.J., House, C.H., Ferry, J.G., and Brantley, S.L. (2007) The effect of methanogen growth on mineral substrates: will Ni markers of methanogen-based communities be detectable in the rock record? *Geobiology*, v. 5, p. 49-61.

Liermann, L.J., Hausrath, E.M., Anbar, A.D. and Brantley, S.L. (2007). Assimilatory and dissimilatory processes of microorganisms affecting metals in the environment. *J. Anal. At. Spectrom.* 2007, v. 22, p. 867 - 877.

Hausrath, E.M., Navarre-Sitchler, A.K., Sak, P., Steefel, C. and Brantley, S.L. (2008) Basalt weathering rates on Earth and the duration of liquid water on the plains of Gusev Crater, Mars. *Geology*, v. 36, p. 67-70.

Hausrath, E.M., Treiman, A.H., Vicenzi, E., Bish, D.L., Blake, D., Sarrazin, P., Hoehler, T., Midtkandl, I., Steele, A., and Brantley, S.L. (2008) Short- and long-term olivine weathering in Svalbard: Implications for Mars. *Astrobiology*, v. 8 (6), p. 1079-1092.

Hausrath, E.M., Neaman, A., Brantley, S.L. (2009) Elemental release rates from dissolving basalt and granite with and without organic ligands. *American Journal of Science*, v. 309, p. 633-660

Hausrath, E.M. and Brantley, S.L. (2010) Basalt and olivine dissolution under cold, salty, and acidic conditions: What can we learn about recent aqueous weathering on Mars? *J. Geophys. Res.*, 115(E12): E12001

Hausrath, E.M., Navarre-Sitchler, A.K., Sak, P.B., Williams, J.Z. and Brantley, S.L., (2011). Soil profiles as indicators of mineral weathering rates and organic interactions on a Pennsylvania diabase *Chemical Geology* v. 290 p. 89-100

Hausrath, E.M. and A.A. Olsen (2013) Using the chemical composition of carbonate rocks on Mars as a record of previous interaction with liquid water. *American Mineralogist* v. 98 p. 897-906. This paper was selected by the editors of *American Mineralogist* as a “notable paper”.

Hausrath, E.M., D.C. Golden, R.V. Morris, D.G. Agresti, and D.W. Ming (2013) Acid sulfate alteration of fluorapatite, basaltic glass and olivine by hydrothermal vapors and fluids: Implications for fumarolic activity and secondary phosphate phases in sulfate-rich Paso Robles soil at Gusev Crater, Mars *J. Geophys. Res.* 118 (1): 1-13

Hausrath, E.M. and O. Tschauner (2013) Natural fumarolic alteration of fluorapatite, olivine, and basaltic glass, and implications for habitable environments on Mars *Astrobiology* 13 (11): 1049-1064

\*Adcock, C.T., E.M. Hausrath, Forster, P. (2013) Readily available phosphate from minerals in aqueous environments on early Mars *Nature Geoscience* 6: 824-827. This paper was featured in the News and Views section of *Nature Geoscience* and attracted considerable popular press.

\*Gainey, S.R., Hausrath, E.M., Hurowitz, J. A. and R.E. Milliken. (2014) Nontronite dissolution rates and implications for Mars *Geochimica et Cosmochimica Acta* 126: 192-211

Devitt, D.A., L.E. Wright, S.A. Shanahan and E. Hausrath (2014) Fate of selenium in a small urban watershed *Environmental Monitoring and Assessment* DOI:10.1007/s10661-013-3609-1

\*Tu, V.M., Hausrath, E.M., Tschauner, O., Iota, V. and Egeland, G.W. (2014) Dissolution rates of amorphous Al- and Fe-phosphates and their relevance to phosphate mobility on Mars. *American Mineralogist* 99:1206-1215. This paper was selected by the editors of *American Mineralogist* as a “notable paper”.

\*Adcock, C.T., Hausrath, E.M., Forster, P.M. and \*Sefein, K.J. (2014) Synthesis and characterization of the Mars-relevant phosphate minerals Fe/Mg-whitlockite and merrillite and a proposed mechanism for whitlockite to merrillite transformation. *American Mineralogist* 99:1221-1232

Olsen, A., Hausrath, E.M., and J.D. Rimstidt (2015) Forsterite dissolution rates in Mg-sulfate-rich Mars-analog brines, and implications for the aqueous history of Mars, *JGR Planets* 120, doi:[10.1002/2014JE004664](https://doi.org/10.1002/2014JE004664)

\*Baumeister, J. L., E. M. Hausrath, A. Olsen, O. Tschauner, \*C.T. Adcock, and R. V. Metcalf (2015). Biogeochemical weathering of serpentinites: An examination of incipient dissolution affecting serpentine soil formation, *Applied Geochemistry* 54: 74-84

Yesavage, T., Thompson, A., Hausrath, E.M., Liermann, L.J. and Brantley, S.L., (2015), Basalt weathering in an arctic Mars analog site. *Icarus*. doi:[10.1016/j.icarus.2015.03.011](https://doi.org/10.1016/j.icarus.2015.03.011)

Dixon, E., Elwood Madden, M.E., Madden, A., and Hausrath, E.M. (2015) Assessing hydrodynamic effects on jarosite dissolution rates, reaction products, and preservation on Mars, *JGR Planets*, 120, doi:[10.1002/2014JE004779](https://doi.org/10.1002/2014JE004779)

\*Adcock, C.T., and Hausrath, E.M. (2015) Weathering profiles in high-P rocks at Gusev Crater, Mars, suggest dissolution of phosphate minerals into near-neutral waters *Astrobiology*, 15(12), 1060-1075.

\*Steiner, M.H., E.M. Hausrath, M.E. Elwood Madden, O. Tschauner, B.L. Ehmman, A.A. Olsen, S.R. Gainey, and J.S. Smith (2016) Dissolution of nontronite in chloride brines and implications for the aqueous history of Mars *Geochimica et Cosmochimica Acta* 10.1016/j.gca.2016.08.035

Marsac, K.E., Burnley, P.C., Adcock, C.T., Haber, D.A., Malchow, R.L., and Hausrath, E.M. (2016) "Modeling background radiation using geochemical data: A case study in and around Cameron, Arizona." *Journal of Environmental Radioactivity*, 165, 68-85.

Schieber, J., Bish, D., Coleman, M., Reed, M., Hausrath, E. M., Cosgrove, J., Gupta, S., Minitti, M. E., Edgett, K. S. and Malin, M. (2017), Encounters with an unearthy mudstone: Understanding the first mudstone found on Mars. *Sedimentology*, 64: 311–358. doi:[10.1111/sed.12318](https://doi.org/10.1111/sed.12318)

Adcock, C.T. °, Tschauner, O. °, Hausrath, E.M. °, Udry, A., Luo, S.N., Cai, Y., Ren, M., Lanzirotti, A., Newville, M., Kunz, M., and Lin, C. (2017) Shock-transformation of whitlockite to merrillite and the implications for meteoritic phosphate. *Nature Communications*, 8, 14667. °Equally contributing authors

Haber, D., Burnley, P.C., Malchow, R.C., Adcock, C.T., Marsac, K.E., and Hausrath, E.M. (2017) Modeling background radiation in Southern Nevada, *Journal of Environmental Radioactivity*. 171:41-64

Hays Lindsay E., Graham Heather V., Des Marais David J., Hausrath Elisabeth M., Horgan Briony, McCollom Thomas M., Parenteau M. Niki, Potter-McIntyre Sally L., Williams Amy J., and Lynch Kennda L.. *Astrobiology*. April 2017, 17(4): 363-400. <https://doi.org/10.1089/ast.2016.1627>. This paper was the 10<sup>th</sup> most downloaded paper from *Astrobiology* in 2017.

\* Gainey, S.R., Hausrath, E.M., Adcock, C.T., Tschauner, O., Hurowitz, J.A., Ehlmann, B.L., Xiao, Y., and Bartlett, C.L. (2017) Clay mineral formation under oxidized conditions and implications for paleoenvironments and organic preservation on Mars. *Nature Communications*, 8(1), 1230.

\*Christopher T. Adcock, Arya Udry, Elisabeth M. Hausrath, Oliver Tschauner (2018) Craters of the Moon National Monument basalts as unshocked compositional and weathering analogs for martian rocks and meteorites. *American Mineralogist* ; 103 (4): 502–516. doi: <https://doi.org/10.2138/am-2018-6193>

#Z. R. Harrold, E. M. Hausrath, A. H. Garcia, A. E. Murray, O. Tschauner, J. Raymond and S. Huang (2018) Bioavailability of mineral-bound iron to a snow algae-bacteria co-culture and implications for albedo-altering snow algae blooms *Applied and Environmental Microbiology* 84 (7)

Hausrath, E. M. , D. W. Ming, T. Peretyazhko, and E. B. Rampe (2018) Reactive transport and mass balance modeling of the Stimson sedimentary formation and altered fracture zones constrain diagenetic conditions at Gale crater, Mars *Earth and Planetary Science Letters*, 491, 1-10

\*Bartlett, C. L, E. M. Hausrath, C. T. Adcock, S. Huang, #Z. R. Harrold, and Arya Udry (2018) Effects of organic compounds on dissolution of the phosphate minerals chlorapatite, whitlockite, merrillite and fluorapatite: Implications for interpreting past signatures of organic compounds in rocks, soils and sediments *Astrobiology Journal* 18 (12) DOI: 10.1089/ast.2017.1739

Francis McCubbin, Brian Phillips, Christopher Adcock, Kimberly Tait, Andrew Steele, John Vaughn, Marc Fries, Viorel Atudorei, Kathleen Vander Kaaden, and Elisabeth Hausrath (2018) Discreditation of bobdownsite and the establishment of criteria for the identification of minerals with essential monofluorophosphate ( $\text{PO}_3\text{F}^{2-}$ ) *American Mineralogist* 103 (8): 1319-1328

#### **BOOK CHAPTER, APPENDIX and REPORT**

International MSR Objectives and Samples Team (iMOST) D. W. Beaty and 71 others including Hausrath (2018) The Potential Science and Engineering Value of Samples Delivered to Earth by Mars Sample Return. Report requested by the International Mars Exploration Working Group (IMEWG)

Brantley, S. L., Lebedeva, M., and Hausrath, E. M. (2012) A geobiological view of weathering and erosion. In: *Fundamentals of Geobiology* (eds. A. H. Knoll, D.E. Canfield, and K. Konhauser) Blackwell Publishing Limited, 2012

Bandstra J.Z., Buss H.L., Campen R.K., Liermann L.J., Moore J., Hausrath E.M., Navarre-Sitchler A.K., Jang J-H. and Brantley S.L. Appendix: Compilation of Mineral Dissolution Rates. In *Kinetics of Water-Rock Interaction* (eds. S. L. Brantley, J. D. Kubicki and A. F. White). Springer, New York. 2008.

#### **EXTENDED ABSTRACTS:**

\* Indicates Hausrath-advised student author # indicates Hausrath-advised postdoctoral author

\*Ralston, S.J., Hausrath, E.M., Tschauner, O., Rampe, E.B. and Christoffersen, R., 2018. Dissolution Rates of Allophane, Fe-Containing Allophane, and Hisingerite and Implications for Gale Crater, Mars, 49th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston, pp. Abstract #2823.

\*Adcock, C.T., Udry, A., Hausrath, E.M. and Tschauner, O., 2018. Craters of the Moon National Monument Basalts as Analogs for Martian Rocks and Meteorites, 49th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston, pp. Abstract #2397.

\*Bamisile, T.A., Hausrath, E.M., Tschauner, O.D., Harrold, Z.R., Adcock, C., Phillips-Lander, C.M., Gainey, S., and Gabriel, R. (2018) Analysis of Iron-Containing Weathering Products in Serpentine Soils and Their Implications for Mars. 49th Lunar and Planetary Science Conference, p. Abstract #2904. Lunar and Planetary Institute, Houston.

#Phillips-Lander, C.M., Harrold, Z.R., Sanchez, A., Sbraccia, P., Garcia, A., Raymond, J., and Hausrath, E.M. (2018) Snow Algae Consortia as Habitability Indicators in Icy Environments. 49th Lunar and Planetary Science Conference, p. Abstract #2365. Lunar and Planetary Institute, Houston.

Board, R.S.S., Beaty, D.W., McSween, H.Y., Carrier, B.L., Czaja, A.D., Goreva, Y.S., Hausrath, E.M., Herd, C.D.K., Humayun, M., McCubbin, F.M., McLennan, S.M., Pratt, L.M., Sephton, M.A., Steele, A., and Weiss, B.P. (2018) Summary of Sample Quality Standards for Returned Martian Samples. 49th Lunar and Planetary Science Conference, p. Abstract #1516. Lunar and Planetary Institute, Houston.

#Phillips-Lander, C.M., Harrold, Z.R., Raymond, J., Tschauner, O., and Hausrath, E.M. (2018) Snow Algae-Bacteria Co-Cultures Exhibit Patterned Growth (Biovermiculation) Under Fe-Limited Conditions: Implications for Biosignatures on Icy Planetary Bodies. 49th Lunar and Planetary Science Conference, p. Abstract #2308. Lunar and Planetary Institute, Houston.

Board, R.S.S., Beaty, D.W., McSween, H.Y., Carrier, B.L., Czaja, A.D., Goreva, Y.S., Hausrath, E.M., Herd, C.D.K., Humayun, M., McCubbin, F.M., McLennan, S.M., Pratt, L.M., Sephton, M.A., Steele, A., and Weiss, B.P. (2018) Analysis of the Scientific Value of the Mars 2020 Spacecraft Genetic Inventory to Mars Sample Return. 49th Lunar and Planetary Science Conference, p. Abstract #1202. Lunar and Planetary Institute, Houston.

Hausrath, E.M., D.W. Ming, T. Peretyazhko and E. B. Rampe (2017) Using reactive transport modeling to understand formation of the Stimson sedimentary unit and altered fracture zones at Gale Crater Mars. 48th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston,

\*Ralston, S.J., E.M. Hausrath, O. Tschauner, E. B. Rampe, J.V. Clark-Hogencampe, R. Christoffersen (2017) Fe-containing allophane and hisingerite dissolution and implications for Gale Crater Mars 48th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston,

C. M. Phillips-Lander, K. Miller, E. M. Hausrath, A.S. Stockton and M.E. Elwood Madden (2017) Light, temperature and nutrient availability influence microbial colonization of lava caves 48th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston,

K. A. Farley and 16 others including E.M. Hausrath (2017) Contamination knowledge strategy for the Mars2020 Sample-collecting rover 48th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston,

Hipkin, V.J. and 16 others, including E. M. Hausrath (2017) Learning from traditional field geology and CanMars Rover-based remote science Science operations approaches to sample selection 48th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston,

Beaty, D. W., R. Hansen, E. M. Hausrath, V. J. Hipkin, C. Maggiori, R. McCoubrey, J. Parrish, and S. J. Ralston (2017) Field validation for the 1016 Can-Mars Field Test 48th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston,

Adcock CT, and Hausrath EM. (2017) Synthesis of Na-bearing Whitlockite and Implications for Interpretation of Extraterrestrial Phosphate Minerals In: 48th Lunar and Planetary Science Conference, LPI, The Woodlands, TX, p #2237.

Adcock CT, and Hausrath EM. (2017) Assessing Habitability on Mars Using Orbiter Data and a Habitability Index. In: 2nd Astrobiology Science Conference, LPI, Mesa, AZ, p #3114

#Z.R. Harrold, E. M. Hausrath, A. E. Murray, O. Tschauner, \*A. H. Garcia, A. Lanzirroti, M. A. Marcus, M. Newville, \*C. L. Bartlett, and J. Raymond (submitted). Iron-bearing minerals as a trace nutrient source for snow algae communities (submitted) to the Astrobiology Science Conference

V. J. Hipkin and 9 others, including E. M. Hausrath (submitted) Validating accuracy of rover-based sample selection approaches with a field validation team: Returned sample analysis and relevance to Mars 2020 (submitted) to the Astrobiology Science Conference

Hausrath, E.M.,# Z. Harrold, A.E. Murray, O. Tschauer, \*A.H. Garcia, \*C.L. Bartlett and J. Raymond (2016) Interactions of Snow Algae, Microorganisms and Minerals in Snowy Mars-analog environments provide potential elemental and mineralogical biosignatures, Biosignature Preservation and Detection in Mars-analog Environments, Abstract # 2050

Adcock, C.T., Tschauer, O. and Hausrath, E.M. (2016) An Investigation of Shock Effects on Mars-Relevant Phosphate Minerals: Shock-Transformation of Chlorapatite, 47th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston, p. Abstract #1577.

\*Bartlett, C.L., Hausrath, E.M. and Adcock, C.T. (2016) Phosphate Release: The Effect of Prebiotic Organic Compounds on Dissolution of Mars-Relevant Minerals, 47th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston, p. Abstract #2754.

Beaty, D.W., McSween, H.Y., Goreva, Y.S., Hausrath, E., Herd, C.D.K., Humayun, M., McCubbin, F.M., McLennan, S.M., Pratt, L.M., Sephton, M.A., Steele, A., Weiss, B.P. and Hays, L.E. (2016) Recommended Maximum Temperature for Mars Returned Samples, 47th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston, p. Abstract #2662.

#Harrold, Z.R., Hausrath, E.M., \*Bartlett, C.L., \*Garcia, A.H., Tschauer, O., Murray, A.E. and Raymond, J. (2016) Bioavailability of Mineral-Bound Iron to a Snow Algae Community and Implications for Life in Extreme Environments, 47th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston, p. Abstract #2720.

Hausrath, E.M., Goetz, W., Cousin, A., Wiens, R.C., Meslin, P.-Y. and Rapin, W. (2016) Signs of Transport of Chemical Elements and Soil-Forming Processes in Surface Soils at Gale Crater, Mars, 47th Lunar and Planetary Science Conference. Lunar and Planetary Institute, Houston, p. Abstract #2493.

Adcock, C.T., and Hausrath, E.M. (2015) Educational experiences for K-12 in the Earth and planetary sciences. Lunar and Planetary Science Conference XXXXVI, Houston, TX Abstract #2330

\*Gainey, S.R., Hausrath, E. M., and Hurowitz, J.A. (2015) Weathering profiles at Mawrth Vallis yield insight into the aqueous history and potential habitability of Mars Lunar and Planetary Science Conference XXXXVI, Houston, TX Abstract 2248

\*Schofield, R.E., Hausrath, E.M., and \*Gainey, S.R. (2015) Zeolite weathering in laboratory and natural settings, and implications for Mars Lunar and Planetary Science Conference XXXXVI, Houston, TX Abstract # 2160

\*Steiner, M.S., Hausrath, E. M., and Elwood Madden, M.E. (2015) Dissolution of nontronite in brines and implications for habitable environments on Mars Lunar and Planetary Science Conference XXXXVI, Houston, TX

\*Bartlett, C.L., Hausrath, E. M., and Adcock, C.T. (2015) Phosphate release: The effect of prebiotic organic compounds on dissolution of Mars-relevant phosphate minerals Lunar and Planetary Science Conference XXXXVI, Houston, TX Abstract # 2451

Elwood Madden, M.E., E.M. Dixon, A.S. Elwood Madden, B.R. Pritchett, and E.M. Hausrath (2015) Low temperature anhydrite precipitation in flowing brines: Implications for calcium sulfate phases observed on Mars Lunar and Planetary Science Conference XXXXVI, Houston, TX Abstract # 1505

Adcock, C.T., Hausrath, E.M., Tschauner, O. and A. Udry (2015) Investigations of shock effects on phosphate minerals in extraterrestrial materials Lunar and Planetary Science Conference XXXXVI, Houston, TX Abstract # 2288

Hausrath, E.M., \*Adcock, C.T., \*Gainey, S.R., \*Steiner, M.H., and V.M. \*Tu, 2014 Experimental evidence suggests significant aqueous alteration and abundant phosphorus release on Mars International Conference on Mars Abstract # 1310

\*Adcock, C.T. and Hausrath, E.M., 2014. Reactive transport modeling of phosphate mineral dissolution in high-P martian rocks, Lunar and Planetary Science Conference XXXXV, Houston, TX, Abstract # 2250.

\* Gainey, S.R., Hausrath, E.M., Hurowitz, J.A. and Tschauner, O., 2014. Formation of aqueous minerals: Implications for the past habitability of Mars, Lunar and Planetary Science Conference XXXXV, Abstract # 2356.

Hausrath, E.M., \*Adcock, C.T., Elwood Madden, M.E., \*Gainey, S.R., Olsen, A.A., and \*Steiner, M.H. (2014) Using geochemical kinetics to interpret potential habitability Lunar and Planetary Science Conference XXXXV, Abstract # 2376

\*Steiner, M.H., Hausrath, E.M. and \*Schofield, R.E., 2014. Dissolution of nontronite by high ionic strength brines and implications for habitable environments on Mars, Lunar and Planetary Science Conference XXXXV, Abstract # 1510.

\*Adcock, C.T. and E.M. Hausrath (2013) Interpretation of phosphate mobility on Mars based on terrestrial Mars-analog basalts and reactive transport modeling Lunar and Planetary Science Conference XXXXIV Houston, TX Abstract # 2727

\*Gainey, S.R., E.M. Hausrath, and J.A. Hurowitz (2013) Clay mineral precipitation and implications for Mars Lunar and Planetary Science Conference XXXXIV Houston, TX Abstract # 2954

\*Steiner, M.H., Hausrath, E.M., and H.J. Sun (2013) Synthesis of potential phosphate mineral biosignatures under Mars-relevant conditions Lunar and Planetary Science Conference XXXXIV Houston, TX Abstract # 2761

\*Tu, V. and E.M. Hausrath (2013) Dissolution of amorphous Al- and Fe-phosphates: Implications for phosphate mobility on Mars Lunar and Planetary Science Conference XXXXIV Houston, TX Abstract # 2577

\*Adcock, C.T. and E.M. Hausrath (2012) The dissolution rate of whitlockite and implications for the habitability of early Mars Lunar and Planetary Science Conference XXXXIII Houston, TX Abstract # 2466

\*S. R. Gainey, E. M. Hausrath and J. A. Hurowitz (2012) , Kinetics of nontronite dissolution and implications for Mars Lunar and Planetary Science Conference XXXXIII Houston, TX Abstract # 2383

\*Tu, V. and E. M. Hausrath (2012) Dissolution rates of amorphous Al- and Fe-phosphates and their relevance to Mars Lunar and Planetary Science Conference XXXXIII Houston, TX Abstract # 2609

Hausrath, E.M., \*Adcock, C.T. and \*Tu, V. (2012) Phosphate records environmental conditions important to habitability in soils and rocks on Mars Lunar and Planetary Science Conference XXXXIII Houston, TX Abstract # 2719

Golden, D.C., D.W. Ming, E.M. Hausrath, R.V. Morris, P.B. Niles, C.N. Achilles, D.K. Ross, B.L. Cooper, C.P. Gonzalez, and S. A. Mertzman (2012) Dissolution of olivine, siderite and basalt at 80°C in 0.1 M H<sub>2</sub>SO<sub>4</sub> in a flow-through process: Insights into acidic weathering on Mars Lunar and Planetary Science Conference XXXXIII Houston, TX Abstract # 2521

Niles, P.B., and 51 others including Hausrath (2012) Multiple smaller missions as a direct pathway to Mars sample return. Mars Exploration Workshop, 2012.

Hausrath, E.M. and \*Tu, V., 2011. Reactive transport modeling of phosphate under Mars-like conditions, Lunar and Planetary Science Conference XXXXII, Houston, TX, Abstract # 2353.

\*Adcock, C.T., Simon, A. and E.M. Hausrath, 2011. Synthesis of phosphate minerals for use in dissolution experiments, Lunar and Planetary Science Conference XXXXII Houston, TX Abstract # 2300

\*Tu, V., \*Baumeister, J.L., Metcalf, R., Olsen, A.A., and Hausrath, E. (2011) Serpentinite weathering and implications for Mars. Lunar and Planetary Science Conference, p. 2303, Houston, TX.

\*Adcock, C.T. and Hausrath, E.M. (2010) Kinetic studies of phosphate-containing minerals and implications for Mars Lunar and Planetary Science Conference XXXXI Abstract # 2177

\*Cornell, J.W. and Hausrath, E.M. (2010) Phosphate mobility in a Mars analog environment. Lunar and Planetary Science Conference XXXXI Abstract # 2141

Hausrath, E.M. (2010) Characterization of fumarolic products in Nevada Lunar and Planetary Science Conference XXXXI Abstract # 2389

Hausrath, E.M., D.C. Golden, C. Galindo, B. Sutter, R.V. Morris, and D.W. Ming (2009) Column experiments to interpret weathering in Columbia Hills Lunar and Planetary Science conference XXXX Abstract # 2423.

Hausrath, E.M., Navarre-Sitchler, A.K., Moore, J., Sak, P.B., Brantley, S.L., Golden, D.C., Sutter, B., Schröder, C., Socki, R., Morris, R.V., Ming, D.W. (2008) Mars sample return: The value of depth profiles. Ground truth from Mars: Science payoff from a sample return mission April 21-23, 2008, Albuquerque, New Mexico

Hausrath, E.M., Golden, D.C., Morris, R.V., and Ming, D.W. (2008) Acid vapor weathering of apatite and implications for Mars. Lunar and Planetary Science Conference XXXIX Abstract #2350

Hausrath, E.M., A.K. Navarre-Sitchler, P.B. Sak, and S.L. Brantley (2007) What can we learn from depth profiles on Mars? Lunar and Planetary Science Conference XXXVIII Abstract #2075

Bish, D.L., D. Blake, P. Sarrazin, A. Treiman, T. Hoehler, E.M. Hausrath, I. Midtkandl, A. Steele (2007) Field XRD/XRF mineral analyses by the MSL CheMin instrument. Lunar and Planetary Science Conference XXXVIII Abstract #1163

Hausrath E. M., Brantley S. L., and AMASE. (2005) Basalt weathering rates in a Mars analog environment: Clues to the duration of water on Mars? Lunar and Planetary Science Conference XXXVI, Abstract #2339

Hausrath E. M., Liermann L. J., and Brantley S. L. (2004) Enhanced dissolution in the presence of methanogens. Water Rock Interactions, 1123-1125.

Hausrath, E.M., Liermann, L.J., and Brantley, S.L. (2003) Enhanced nickel release in the presence of methanogens: Evidence for a nickel binding ligand? 226<sup>th</sup> meeting of the American Chemical Society, New York City, NY

Barrash, W., Knoll, M.D., Hyndman, D., Clemo, T., and Hausrath, E.M., 2003, Tracer/Time-Lapse Radar Imaging Test at the Boise Hydrogeophysical Research Site: SAGEEP'03 Symposium on the Applications of Geophysics to Environmental and Engineering Problems, April 6-10, 2003, San Antonio, TX, p.163-174.

#### **ABSTRACTS AND OTHER PUBLICATIONS:**



#Z. R. Harrold, E. M. Hausrath, O. Tschauer, A. E. Murray, M.A. Marcus, A. Lanzirotti, M. Newville, \*A. H. Garcia, \*C. L. Bartlett and J. A. Raymond (2016) Snow algae-microbe-mineral interactions and implications for snow algae growth American Geophysical Union Fall Meeting, San Francisco.

Beatty, D. and 16 others, including E. M. Hausrath (2016) Planning for the collection of a science-rich set of Mars samples in support of a potential future Mars Sample Return Geological Society of America, Denver CO 2016

Schroder, C., Mao, J., Hausrath, E.M., Morris, R.V., Squyres, S.W., and Haderlein, S.B., (2014) Possible association of ferrous phosphates and ferric sulfates in hydrothermal deposits in Gusev Crater, Mars. 14<sup>th</sup> European Astrobiology Conference (EANA 2014), Edinburgh, Scotland, October 13-16 2014

Hausrath, E.M., \*Downs, B. and Holmden, C. (2014) Ca isotopic composition reflects evapotranspiration and dust inputs in shallow desert soil Mineralogical Magazine 77 (5) 932

Hausrath, E.M., A.A. Olsen, J.L. Baumeister, E. Yardley, M. Bodkin, K. Negrich Biogeochemical weathering of serpentinites: An examination of the first reactions controlling serpentine soil formation Soil Science Society of America Meeting, Cincinnati, OH, October 21-24 2012. (invited)

Hausrath, E.M., C.T. Adcock, S. Gainey, J. Hurowitz, V. Tu. Laboratory experiments on Mars-relevant clay and phosphate minerals yield insights into the aqueous history and potential for habitability on Mars. The American Geophysical Union, San Francisco, CA Dec 3-7 2012. (invited)

Hausrath, E.M., \*Adcock, C.T., \*Tu, V. (2012) Interpreting phosphate mobility on Mars and the implications for habitability. Goldschmidt Conference, 2012.

Hausrath, E.M. (2011) Hydrothermal and pedogenic carbonates constrain liquid water on Mars. American Geophysical Union Fall Meeting, San Francisco.

\*Adcock, C.T., and E.M.Hausrath. (2011) Dissolution rates and mineral lifetimes for phosphate-containing minerals and implications for Mars. American Geophysical Union Fall Meeting, San Francisco.

\*Baumeister, J.L., \*Tu, V., \*Evert, M., Metcalf, R., Olsen, A.A., and Hausrath, E.M. (2011) Chemical weathering of serpentinites in the Klamath Mountains, California. Geological Society of America, St Paul, Minnesota.

\*Myers, B., Hausrath, E., and McDonnell, S. (2011) The impact of creosote bush (*Larrea tridentata*) and biological soil crust on Ca distribution in arid soils of the Mojave Desert, Southern Nevada Geological Society of America, St. Paul, Minnesota.

Elwood Madden, Megan. E., Hausrath, Elisabeth M., Olson, Amanda, and Madden, Andrew (2010) From theory to observation: The data driven transition from thermodynamics to kinetics in Mars geochemistry. GSA Annual Meeting, Denver, Colorado.

\*Baumeister, J.L., \*Tu, V., Olsen, A.A., and Hausrath, E. M. (2010) Chemical weathering rates of olivine and serpentine in natural environments. GSA Annual Meeting, Denver, Colorado

E.M. Hausrath (2010) Fumarolic alteration and implications for Mars. Geochimica et Cosmochimica Acta 74 (12 Supplement 1) A387

C. Schröder, E.M. Hausrath, D.C. Golden, D.W. Ming, R.V. Morris, and G. Klingelhöfer (2008) Evidence for ferrous phosphates in Paso Robles soils, Gusev Crater, Mars, GSA Annual Meeting, Houston, TX

- Hausrath, E.M., Golden, D.C., Morris, R.V., and Ming, D.W. (2008) Phosphate alteration on Mars Goldschmidt Conference, Vancouver, British Columbia
- Hausrath, E.M., Navarre-Sitchler, A.K., Sak, P.B., Steefel, C., and Brantley, S.L. (2007) Basalt weathering rates on Earth and the duration of water on Mars *Geochimica et Cosmochimica Acta* 71 (15S) A387
- Fletcher, R., Hausrath, E., Navarre-Sitchler, A., Peightal, B., and Brantley, S. (2007) The weathering engine conveyor belt and corestone size distributions *Geochimica et Cosmochimica Acta* 71 (15S) A285
- Navarre-Sitchler, A., Steefel, C., Hausrath, E., and Brantley, S. (2007) Influence of porosity on basalt weathering rates from the clast to the watershed scale *Geochimica et Cosmochimica Acta* 71 (15S) A707
- Peightal, Brian Mark, Navarre-Sitchler, Alexis K., Hausrath, Elisabeth M., Brantley, Susan L. (2007) Soil profiles as indicators of mineral weathering rates in basalt Northeastern Section GSA Durham, New Hampshire
- Hausrath, E.M., Sak, P.B., Navarre-Sitchler, A.K., Williams, J.Z., Cabret, E.J., and Brantley, S.L. (2006) Gradients in mineralogy and element composition at the bedrock-regolith interface record mineral reaction and transport rates GSA Annual Meeting Philadelphia, PA
- Brantley S. L., Fletcher R. C., Buss H., Moore J., Hausrath E., Navarre A., Lebedeva M., and White A. F. (2006) Weathering from the soil profile to the watershed: what controls the weathering advance rate? *Geochimica et Cosmochimica Acta* 70(18, Supplement 1), 1.
- Hausrath, E.M., Navarre, A.K., Steefel, C.I. and Brantley, S.L. (2006) Reactive transport modeling of basalt weathering under Mars-like conditions Astrobiology Science Conference, Washington, DC
- Brantley, S.L., Liermann, L. J., and Hausrath, E.M. (2006) Investigating the potential for trace metal biosignatures in the rock record Astrobiology Science Conference, Washington, DC
- Sak, P., Hausrath, E.M., Navarre, A.K., and Brantley, S.L. (2005) The persistence of rock-forming minerals in the soil environment. Earth Systems Processes 2 Calgary, Alberta.
- Hausrath E. M., Neaman A., and Brantley S. L. (2005) Basalt and granite dissolution rates in the presence of citrate. Goldschmidt Conference, Moscow, Idaho.
- Hausrath E. M., Neaman A., and Brantley S. L. (2005) Trace element mobility in the presence of organic acids: A potential "organomarker"? NASA Astrobiology Institute 2005 Biennial Meeting, 286.
- Hausrath, E.M., Liermann, L.J. and Brantley, S.L. (2004) Influence of methanogens on mineral weathering Astrobiology Science Conference, NASA, Ames
- Oldenborger, G., Buursink, M., Moret, G., Goldstein, S., Johnson, T., Reboulet, E., Hughes, C., and Hausrath, E., 2002, Tracer/time-lapse imaging test at the Boise Hydrogeophysical Research Site (abs.): Inland Northwest Research Alliance, Subsurface Science Symposium, Boise, 13-16 October 2002.
- Hausrath, E.M., Barrash, W., and Reboulet, E.C., 2002, Water Sampling and Analysis for the Tracer/Time-Lapse Radar Imaging Test at the Boise Hydrogeophysical Research Site: Report to EPA for Grant X-970085-01-0 and to the U.S. Army Research Office for Grant DAAH04-96-1-0318, Center for Geophysical Investigation of the Shallow Subsurface Technical Report BSU CGISS 0203, Boise State University, Boise, ID, 86 p.
- Barrash, W., Clemo, T., Hyndman, D.W., Reboulet, E., and Hausrath, E.M., 2002, Tracer/Time-Lapse Radar Imaging Test; Design, Operation, and Preliminary Results: Report to EPA for Grant X-970085-01-0 and to the U.S.

Army Research Office for Grant DAAH04-96-1-0318, Center for Geophysical Investigation of the Shallow Subsurface Technical Report BSU CGISS 0202, Boise State University, Boise, ID, 120 p.

### INVITED TALKS

- “Weathering on Earth and on Mars” The Smithsonian Institution, Washington, DC September 2007  
“Interpreting Phosphate Mobility on Mars” The Geological Society of Nevada, Southern Chapter, Las Vegas, NV January 2010  
“Biogeochemical weathering of serpentine minerals from bedrock to soil” Critical Zone Observatories All Hands Meeting, Tucson, AZ May 2011  
“Interpreting signatures of aqueous alteration on Earth and on Mars” Michigan State University, November 2011  
“Interpreting signatures of aqueous alteration on Earth and on Mars” UNLV Chemistry Department, November 2011  
“Interpreting aqueous alteration on Earth and on Mars” University of Oklahoma, August 2012  
“Interpreting aqueous alteration on Earth and on Mars” University of Nevada, Reno 2012  
“Biogeochemical weathering of serpentinites: An examination of the first reactions controlling serpentine soil formation”. E.M Hausrath (presenter) A.A. Olsen, J.L.\* Baumeister, E. Yardley, M. Bodkin, K. Negrich Soil Science Society of America Meeting, Cincinnati, OH, October 21-24 2012.  
“Laboratory experiments on Mars-relevant clay and phosphate minerals yield insights into the aqueous history and potential for habitability on Mars”. E.M. Hausrath (presenter) C.T. \*Adcock, S. \*Gainey, J. \*Hurowitz, V. \*Tu. The American Geophysical Union, San Francisco, CA Dec 3-7 2012.  
“Evidence for widespread aqueous alteration and abundant phosphorus release on Mars” University of South Florida, April 2014  
“Interpreting phosphate mobility in early, potentially habitable environments on Mars” Pardee Keynote Symposia GSA, Vancouver, BC October 2014  
“Interpreting aqueous alteration on Earth and on Mars using field analyses, laboratory experiments and modeling” GSA, Vancouver, BC October 2014  
“Interactions of snow algae, microorganisms and minerals in snowy environments” Nevada Native Plant Society, Henderson, Nevada September, 2016  
“Interactions of snow algae, microorganisms, and minerals in snowpack: Implications for Earth’s albedo and potential biosignature formation” American Chemical Society National Meeting April 2017  
“Investigating weathering of basaltic materials in Gale Crater, Mars: A combined laboratory, modeling, and terrestrial field approach, GSA, Seattle WA, October 2017  
“Weathering profiles in soils and rocks on Earth and Mars” The American Geophysical Union, New Orleans, LA Dec 2017  
“What causes pink snow?: Interactions of snow algae, minerals and microorganisms in low-nutrient snowy environments Science Café, Las Vegas, Nevada, March 2018  
“Interactions of snow algae, microorganisms, and minerals in snowpack: Implications for Earth’s albedo and potential biosignature formation” University of Texas, El Paso, April 2018  
“Porosity formation and weathering products in young serpentine soils” SSSA, San Diego, CA January 2019

### AWARDS

Barrick Scholar Award	2015
Regents’ Rising Researcher Award	2016
College of Sciences Distinguished Researcher	2018

### SCIENTIFIC SESSIONS AND CONFERENCES ORGANIZED

Audrey Bouvier, Carolyn Crow, James Darling, Christopher Glein, Elisabeth Hausrath, Larry Nittler, Tanya Peretyazhko, Steve Vance “Geochemists infiltrate the Solar System: the Geological Evolution of Small Bodies, Moons and Planets, at the Goldschmidt Conference Boston, MA, 2018

L. Hays, D. Beaty, M. Voytek, M. Meyer (convenors) A. Allwood, N. Cabrol, W. Calvin, D. Des Marais, J. Farmer, E. Hausrath, B. Horgan, R. Leveille, A.-L. Reysenbach (scientific organizing committee) “Biosignature preservation and detection in Mars-analog environments” Lake Tahoe, NV May 16-19, 2016

E. Marin-Spiotta, J. Chorover, C. Rasmussen, L. Jin, A. Olsen, E. Hausrath (organizers) “Organo-Mineral Interactions in the Critical Zone: Mineral Weathering and Carbon Stabilization in Soil” at the Goldschmidt Conference, Knoxville, TN 2010

Brantley, S.L., Michalski, J., Hausrath, E. (organizers) “Chemical and physical weathering of basalt on the Earth, Moon and Mars” at the Goldschmidt Conference, Cologne, Germany, 2007

Eigenbrode, J., Fries, M., Hausrath, E. (organizers) “Interdisciplinary research in cold Mars-analogue environments” at the Astrobiology Science Conference, Washington, DC, 2006

### **CONTRIBUTIONS TO THE UNIVERSITY AND THE PROFESSION**

**Member:** Returned Sample Science Board for the Mars 2020 mission 2015-2018

**Reviewer for:** Nature, Science Advances, Nature Geoscience, Nature Communications, Geochimica et Cosmochimica Acta, Earth and Planetary Science Letters, Chemical Geology, Geochemical Journal, Arctic, Antarctic and Alpine Research, Chemical and Engineering Science, Icarus, The Soil Society of America Journal, JGR Planets, NSF, Mars Fundamental Research Program, Mars Data Analysis Program, NASA Earth and Space Science Fellowship Program, NASA Postdoc Program, Nevada NASA Space Grant Consortium, NASA Astrobiology: Exobiology and Evolutionary Biology Program, NASA Astrobiology Institute

**Funding review panels:** I have served as a panel reviewer on four NASA funding review panels, and chaired one NASA review panel.

**University service:** I am currently serving as the Graduate Admissions Coordinator for the Geoscience Department (2016- present) managing two admissions cycles per year, chairing the Graduate Admissions committee, and co-chairing the Graduate College Awards committee. I served as Undergraduate Coordinator (2012-2015) for the ~200 students in the Geoscience Department. I have also served as a McNair Faculty Mentor in the McNair Scholars Institute, which has the goal of encouraging and preparing undergraduate students who are members of underrepresented groups to pursue doctoral studies and I also served on the Advisory Board of the Multicultural Program at UNLV (2013-2014), which has the goal of increasing the number of minority and underrepresented groups in the STEM and health related sciences. I have served on the Sabbatical Committee (2009-2014), 4 Geoscience Department faculty search committees, chaired one Geoscience Department faculty search committee, the Geoscience Undergraduate Assessment Committee (2013 – 2015), the College of Science Undergraduate Curriculum Committee (2012 – 2015), the Geoscience Department Listening to Departments Committee (chaired Spring 2013, member Spring 2011), the Geoscience Department Graduate Admissions Committee, (2009-2012), on the Geoscience Department Personnel committee (2016- present) and as chair of the Geoscience Department Curriculum Committee (2012- 2015). I have also mentored twelve undergraduate students working in my laboratory while at UNLV.

**Outreach:** I have spoken at outreach events including the Rebel Preview (2x), a recruiting event for local high school students, a recruiting talk at the College of Southern Nevada, Nate Mack and Coral Academy Elementary Schools, and my recent research has been covered in the media by NBC News, CBS news, New Scientist, Las Vegas Guardian Express, Fox News, The Oregon Herald, and others.

### **SUMMARY OF RESEARCH INTERESTS**

Water-rock interactions on Earth and on Mars; soil-forming processes; astrobiology; geomicrobiology; kinetics of mineral dissolution and precipitation; biological impacts on weathering; mineral biosignatures; reactive transport modeling; the effect of climate on weathering

### **GRADUATE AND POSTDOCTORAL ADVISEES**

Anthony Feldman – PhD in progress at UNLV

Ngoc Luu – PhD in progress at UNLV

S.J. Ralston – MS 2018 – currently employed by Jacobs at NASA Johnson Space Center

Charity Phillips-Lander – Postdoctoral scholar 2017-2018

Courtney Bartlett – MS 2017

Zoe Harrold – Postdoctoral school 2016-2017 – currently employed at DRI

Seth Gainey – (PhD 2015) Currently employed in industry

Christopher Adcock – (PhD 2014), postdoctoral scholar 2014-2015, currently employed as an assistant research professor

Michael Steiner – (MS 2015) – Currently employed at the National Park Service

Valerie Tu – (MS 2013) – Currently employed by Jacobs at NASA Johnson Space Center.

Brittany Myers (MS 2012) – Currently employed at a state environmental agency

Julie Baumeister (MS 2012) – Currently employed at an environmental consulting company