

**Magdalena R. Osburn**

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**Major Professional Interests**

- Geobiology of extreme environments including the deep subsurface, caves, hypersaline lakes, hydrothermal systems, and ultrabasic systems
- Compound-specific isotope organic geochemistry (H, C, N) applied to microbial ecology, biogeochemical cycling in microbe-rich environments, and the sedimentary record of environmental perturbation and climate
- Neoproterozoic chemical evolution of the ocean-atmosphere system
- Carbonate sedimentology, stratigraphy, and geochemistry with an emphasis on microbialite preservation and morphology

**Education**

- 2013 Ph.D. Geobiology, California Institute of Technology, Division of Geological and Planetary Science
- 2008 M.S. Geobiology, California Institute of Technology, Division of Geological and Planetary Science
- 2007 B.A. summa cum laude, Earth & Planetary Sciences, Environmental Studies, Washington University in St. Louis

**Employment**

- 2014 – present Assistant Professor, Northwestern University
- 2013 – 2014 Postdoctoral Scholar, University of Southern California
- 2007 – 2013 Graduate student, California Institute of Technology
- 2003 – 2007 Undergraduate Research Assistant, Washington University in St. Louis.

**Postdoctoral Recognition with Dates**

- 2020 Scialog Fellow
- 2019 CIFAR Fellow
- 2019 Kavli Fellow
- 2018 Northwestern University Associated Student Government Faculty and Administrator Honor Roll
- 2017 Packard Fellowship Award

**Pre-Doctoral Awards, Honors, and Fellowships**

- 2013 Dean's Award, Recognition of Service to Graduate Honor Counsel, Caltech
- 2013 Dean's Award, Recognition of Service to Graduate Student Counsel, Caltech
- 2012 Student poster award, 2<sup>nd</sup> place, Gordon Conference on Organic Geochemistry
- 2012 AAPG Student Oral Awards Competition, 2<sup>nd</sup> place, American Association of Petroleum Geologists Annual meeting
- 2012 BASIN Student Registration Grant for the Fall AGU Meeting (poster award)
- 2009 Graduate Research Fellowship Award, National Science Foundation

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2007 The Ernest L. Ohle, Jr. Prize, Department of Earth and Planetary Science, Washington University

### **Current Research Support**

*Earth 4D – Subsurface Science and Exploration*, Canadian Institute for Advanced Research (CIFAR), \$22,914 with renewal for 5 years, July 2019 to June 2020, **Magdalena Osburn** (Co-PI/Fellow)

*Biofilms in the Deep Subsurface: Implications for Planetary Habitability*, NASA NESSF, \$45,000, Sept. 2018 to Sept. 2019 with renewal for 3 years, **Magdalena Osburn** (PI), Caitlin Casar (Fellow).

*Biosignature Preservation in Sulfate-Dominated Hypersaline Environments*, NASA Exobiology, \$197,803 sub award. April 2018 to April 2021, Alex Pontefract (PI), Christopher Carr, **Magdalena Osburn** (CoI)

*Illuminating microbial dark matter using subterranean geomicrobiology*, The David and Lucile Packard Foundation Fellowships for Science and Engineering, \$875,000. Nov 2017 to Oct 2022. **Magdalena Osburn** (PI)

*Biologic and Resource Analog Investigations in Low Light Environments (BRAILLE)*, NASA PSTAR program, \$3,845,449 total (\$182,790 to MRO). May 2017 to April 2020. Jennifer Blank (PI), Tamar Cohen, Anthony Colaprete, Saugata Datta, Matthew Deans, Duane Moser, Diana Northrup, **Magdalena Osburn**, Ted Roush, Carol Stoker, Uland Wong

### **Past Research Support**

*Lipid Biomarkers of the Deep Subsurface Biosphere*, NASA Exobiology (NNX15AM086), \$394,957. June 2015 to June 2018, **Magdalena Osburn** (PI)

*An evaluation of sedimentary lipid hydrogen isotopes as an Arctic precipitation proxy*, NSF Doctoral Dissertation Research, \$16,000. Sept 2016 to Feb 2018, Jamie McFarlin, Yarrow Axford (PI), **Magdalena Osburn** (CoI)

*Life Underground*, NASA Astrobiology Institute (NNAI3AA92A), \$205,077 sub-award to MRO. Jan 2015 to Dec 2017, Jan Amend (PI), **Magdalena Osburn**, Victoria Orphan, Rohit Bhartia, Duane Moser, Moh El-Naggar, Ken Nealson, Beth Orcutt

*Biomarker Records of Arctic Climate Change*, Institute for Sustainability and Energy at Northwestern University (Project # 10038997), \$34,000. Jan 5, 2015 to Jan 4, 2016, **Magdalena Osburn** (PI)

### **Publications**

[24] Casar, C.P.\*, Kruger, B.R., Flynn, T.M., Masterson, A.L., Momper, L.M.\*, **Osburn, M.R.**, (2020) Mineral-hosted biofilm communities in the continental deep subsurface, Deep Mine Microbial Observatory, SD, USA. *Accepted at Geobiology Feb. 2020*

[23] McFarlin, J.M.\*, Axford, Y., Masterson, A., **Osburn, M.R.**, (2019) Calibration of modern sedimentary d2H plant wax-water relationships in Greenland lakes *Quaternary Science Reviews* 225, 1-14. <https://doi.org/10.1016/j.quascirev.2019.105978>

[22] **Osburn, M.R.**, Kruger, M., Masterson, A., Casar, C.\*, Amend, J., (2019) Establishment of the Deep Mine Microbial Observatory (DeMMO), South Dakota, USA. a geochemically stable portal into the deep subsurface. *Frontiers in Earth Science* 7, 1-17. doi: 10.3389/feart.2019.00196.

[21] Lollar, G., Warr, O., Telling, J., **Osburn, M.**, Sherwood Lollar, B., (2019) 'Follow the Water': Hydrogeochemical Constraints on Microbial Investigations 2.4 km below surface at the Kidd Creek Deep Fluid and Deep Life Observatory. *Geomicrobiology Journal* <https://doi.org/10.1080/01490451.2019.1641770>

[20] Meyer-Dombard, D.R., **Osburn, M.R.**, Cardace, D., (2019) The effect of a tropical climate on available nutrient resources to springs in ophiolite-hosted, deep biosphere ecosystems in the Philippines. *Frontiers in Microbiology* 10, 1-19. doi: 10.3389/fmicb.2019.00761.

[19] Lang, S.Q., **Osburn, M.R.**, Steen, A.D., Chapter 14: Carbon in the deep biosphere: Forms, Fates, and biogeochemical cycling. Whole Earth Carbon: Past to Present, edited by Beth N. Orcutt, *Invited contribution in press for Cambridge University Press*.

[18] Stamenkovic V., Beegle L. W., Zacny K., ... **Osburn M. R.**, ... (2019) The next frontier for planetary and human exploration. *Nature Astronomy* 3, 116-120.

[17] Andrews, M.G.\*, Jacobson, A.D., **Osburn, M.R.**, Flynn, T.M., (2018) Dissolved carbon dynamics in meltwaters from the Russell Glacier, Greenland Ice Sheet. *Journal of Geophysical Research: Biogeosciences*, 123. <https://doi.org/10.1029/2018JG004458>

[16] McFarlin, J.M.\*, Axford, Y., **Osburn, M.R.**, Kelly, M., Osterberg, E., Farnsworth, L. (2018) Pronounced summer warming in northwest Greenland during the Holocene and Last Interglacial. *PNAS* doi/10.1073/pnas.1720420115

[15] Chang, R., Bird, L., Barr, C., Wilbanks, E., **Osburn, M.**, Nealon, K., Rowe, A. (2018) *Thioclava electrotophica* sp. nov., a versatile electrode and sulfur oxidizing bacterium from marine sediments. *IJSEM*, 68: 1652-1658, doi: [10.1099/ijsem.0.002723](https://doi.org/10.1099/ijsem.0.002723)

[14] Johnson, D.B.\*, Beddows, P., Flynn, T., **Osburn, M.R.** (2017) Microbial diversity and biomarker analysis of modern freshwater microbialites from Laguana Bacalar, Mexico, *Geobiology* 16, 319-337

[13] Momper, L., Kiel Reese, B., Zinke, L., Wanger, G., **Osburn, M.R.**, Moser, D, and Amend, J.P., (2017) Major phylum-level differences between porefluid and host rock bacterial communities in the terrestrial deep subsurface, *Environmental Microbiology Reports* 9, 501-511

[12] Hardisty, D. S., Lu, Z., Bekker, A., Diamond, C. W., Gill, B. C., Jiang, G., Kah, L. C., Knoll, A. H., Loyd, S. J., **Osburn, M.R.**, Planavsky, N. J., Wang, C., Zhou, X., and Lyons, T. W., (2017) Perspectives on Proterozoic surface ocean redox from iodine contents in ancient and recent carbonate. *EPSL* 463 159-170

[11] **Osburn, M. R.**, Dawson, K. S., Fogel, M. L., & Sessions, A. L., (2016) Fractionation of Hydrogen Isotopes by Sulfate- and Nitrate-Reducing Bacteria. *Frontiers in Microbiology* 7, 318–316.

[10] Kublanov, I.V., **Osburn, M.R.**, Toshchakov, S.V., Novikov, A.A., Bonch-Osmolovskaya, E.A., Perevalova, A.A., Kochetkova, T.V., (2016) *Thermogladius calderae* gen. nov., sp. nov.,

an anaerobic, hyperthermophilic crenarchaeote from a Kamchatka hot spring. *IJSEM* 66, 1407–1412.

[9] Dawson, K.S., **Osburn, M.R.**, Sessions, A.L. and Orphan, V.J., (2015) Metabolic associations with archaea drive shifts in hydrogen isotope fractionation in sulfate-reducing bacterial lipids in co-cultures and methane seeps. *Geobiology* 13, 462-477.

[8] **Osburn, M.R.**, Owens, J., Bergmann, K.D., Grotzinger, J.P., and Lyons, (2015) Timothy W. Dynamic changes in sulfate isotopes preceding the Ediacaran Shuram Excursion. *Geochimica et Cosmochimica Acta*. 170, 204-224.

[7] **Osburn, M.R.**, LaRowe, D.E., Momper, L., Amend, J.P., (2014) Chemolithoautotrophy in the continental deep subsurface biosphere: Sanford Underground Research Facility (SURF), USA. *Frontiers in Extreme Microbiology*, doi: 10.3389/fmicb.2014.00610

[6] **Osburn, M.R.**, Grotzinger, J., Bergmann, K.B., (2013) Stratigraphic characterization of an Ediacaran aged carbonate ramp: Khufai Formation, Sultanate of Oman. *AAPG Bulletin* 98, 1631-1667.

[5] Meyer-Dombard, D., Amend, J.P., **Osburn, M.R.**, (2013) Microbial diversity and potential for arsenic and iron biogeochemical cycling at an arsenic rich, shallow-sea hydrothermal vent (Tutum Bay, Papua New Guinea). *Chemical Geology* 348, 37.

[4] **Osburn, M.R.**, Sessions, A.L., Pepe-Ranney, C., Spear, J.R., (2011) Hydrogen-isotopic variability in fatty acids from Yellowstone National Park hot spring microbial communities. *Geochimica Cosmochimica Acta* 75, 4830.

[3] **Osburn, M.R.**, Amend, J.P., (2011) *Thermogladius shockii* gen. nov., sp. nov., a hyperthermophilic crenarchaeote from Yellowstone National Park, USA. *Archives of Microbiology* 193, 45.

[2] Timmer, R., Woodward, L., Kempter, K., Kelley, S., Osburn, R., **Osburn, M.**, Buffler, R., and Lawrence, J.R. (2006). Preliminary geologic map of the Jarosa quadrangle, Rio Arriba County, New Mexico, New Mexico Bureau of Mines and Mineral Resources, Open-file Geologic Map OF-GM 128, scale 1:24,000.

[1] Kelley, S., Osburn, G.R., Ferguson, C., Kempter, K., and **Osburn, M.**, (2004). Preliminary geologic map of the Seven Springs 7.5-minute quadrangle, Sandoval County, New Mexico, New Mexico Bureau of Geology and Mineral Resources, Open-file Geologic Map OF-GM 88, scale 1:24,000.

\* Indicates a Northwestern student or post doc

### **Works Now in Progress**

#### *Manuscripts Submitted and In Revision:*

Dion-Kirschner, H.\*, McFarlin, J.M.\*, Masterson, A., Axford, Y., **Osburn, M.R.**, Evaluation of plant wax paleoclimate proxies, Part II: Quantifying plant wax sources in west Greenland and application to a late Holocene paleohydrologic reconstruction. *In revision at GCA*

Puleo, Peter J. K.\*, Axford, Y., McFarlin, J.M.\*, Curry, B.B., Barklage, M., **Osburn, M.R.**, Late glacial and Holocene paleoenvironments in the midcontinent United States, inferred from Geneva Lake leaf wax, ostracode valve, and bulk sediment chemistry. *Submitted to QSR*

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Soares, A., Edwards, A., An, D., Bagnoud, A., Bradley, J., Barnhart, E., Bomberg, M., Budwill, K., Caffrey, S. M., Fields, M., Gralnick, J., Kadnikov, V., Momper, L., **Osburn, M.**, Mu, A., Moreau, J.W., Moser, D., Purkamo, L., Rassner, S. M., Sheik, C. S., Sherwood Lollar, B., Toner, B. M., Voordouw, G., Wouters, K., Mitchell, A. C., A global perspective on bacterial diversity in the terrestrial deep subsurface. *In revision at Nature Geoscience*

A.R. Rowe, K. Abuyen, B.R. Lam, B. Kruger, C.P. Casar\*, **M.R. Osburn**, M.Y. El-Naggar, J.P. Amend, Electrochemical evidence for in situ microbial activity at the Deep Mine Microbial Observatory (DeMMO), South Dakota, USA. *Submitted to Geobiology*

\* Indicates a Northwestern student or post doc

### **Research areas in progress:**

*Biosignatures in Salt:* While it is common knowledge that salt has a strong preservative effect on organic matter, the differential behavior of different salts and their effects on different structural categories of organic matter is poorly characterized. My laboratory is investigating magnesium sulfate dominated hypersaline lakes in British Columbia, CA to characterize the preservative potential of sulfate salts on lipid biomarkers. This project involves strong field, laboratory, and analytical components.

*Geobiology of the deep subsurface biosphere:* A primary focus of my laboratory is to understand the biogeochemistry and biosignature production of subterranean microorganisms. My primary field site is the former Homestake Gold Mine, where I have developed the deep mine microbial observatory, a network of subsurface sampling ports and are monitoring the composition of geological fluids and associated microbiology through time. Other field sites include deep mines in Canada and deep wells in the SW USA.

*Geobiology of Caves:* My work on the deep subsurface has led me to question how microbial lifestyles transition with depth in the crust from soils down to great depth. Caves are key portals into the shallow subsurface biosphere and can tap inputs from both the surface (drips) and from upwelling deep fluids (seeps). I am investigating the microbial ecology and biosignatures of cave environments to constrain microbes in this landscape. Field locations for this work include Mammoth Cave National Park, KY, USA, Lava Beds National Monument, CA, USA, and submerged caves in the Yucatán Peninsula, Mexico.

*Paleoclimate and proxy development:* My laboratory is producing detailed records of paleoclimate in Greenland using hydrogen isotopes of organic matter and working to better characterize modern plants and sediments to constrain interpretation of past records. We have recently extended this work to include salinity records of the Christmas Islands using the same techniques.

*Lipid membrane composition of extreme organisms:* I am continuing to advance my work on lipid membrane composition of extremophiles through analysis of organisms from ultrabasic systems as well as subsurface organisms.

*Cultivation of microbial dark matter:* Most microorganisms have not been cultured in the laboratory, limiting our ability to understand their physiology. My lab is actively attempting to cultivate these unusual organisms using a variety of novel techniques. This work is the subject of my Packard Fellowship.

## Professional Talks and Presentations

### *Invited departmental seminars:*

March 2020	Georgia Tech (Pending)
October 2019	Rice University
March 2019	Washington University in St. Louis
April 2018	University of Oklahoma
October 2017	Northern Illinois University
February 2017	University of Chicago
February 2015	University of Iowa
March 2015	University of Illinois Urbana-Champaign
October 2015	University of Illinois Chicago

### *Conference Presentations:*

#### *Select presentations given by me:*

*Illuminating Microbial Dark Matter using Subterranean Geomicrobiology*, **M.R. Osburn**, C. Casar, C. Webster, L. Momper, Packard Fellows Meeting 2019, Monterey, CA.

*Organic Biosignatures of Mars Analog Sulfate-Dominated Hypersaline Lakes*, **M.R. Osburn**, H. Dion-Kirschner, C. Carr, and A. Pontefract, Astrobiology Science Conference, Seattle WA, 2019.

*Understanding the deep subsurface microbiome: Insights from geochemistry and environmental microbiology*, **M.R. Osburn**, C. Casar, T. Flynn, B. Kruger, J. Amend, D. Meyer-Dombard, University of Chicago Microbiome Symposium, Chicago, IL. (*Invited*)

*Geobiology of the Deep Mine Microbial Observatory*, C. Casar, L. Momper, A. Masterson, T. Flynn, B. Kruger, J. Amend. Geobiology Society Meeting, Banff, Alberta, CA. (*Invited*)

*Using geochemical insights to illuminate deep subsurface microbiology*, **M. Osburn**, C. Casar, T. Flynn, B. Kruger, American Chemical Society Annual Meeting, Orlando FL (*Invited*)

*Life in Land: the deep continental biosphere and its implications for planetary habitability*, **M.R. Osburn**, Thirtieth Annual Kavli Frontiers of Science Symposium, Irvine CA (*Invited*)

*Astrobiological characterization of biosignatures from a planetary lava cave analog*, **M.R. Osburn**, B. Kruger, S. Datta, J.J.M. Hathaway, D. Moser, D.E. Northup, K. Papp, J.G. Blank, Goldschmidt Conference 2018, Boston USA

*Illuminating Microbial Dark Matter using subterranean geomicrobiology*, **M.R. Osburn**, Packard Fellows 30<sup>th</sup> Reunion 2018, San Diego, USA

*Carbon Cycling and Microbial Ecology in the Deep Mine Microbial Observatory*, **M. Osburn**, B. Kruger, T. Flynn, C. Casar. GRC Geobiology, January 2018, Galivston TX

*Stable, geochemically mediated biospheres in the Deep Mine Microbial Observatory, SD, USA*, **M.R. Osburn**, C. Casar\*, B. Kruger, T.M. Flynn, Meeting of the American Geophysical Union 2017, New Orleans LA

*Multi-proxy reconstruction of hydroclimate from two interglacial periods in northwest Greenland*, **M. Osburn**, J. McFarlin\*, G. Lasher\*, M. Kelly, E. Osterberg, and Y. Axford, International Meeting of Organic Geochemistry, September 2017, Florence IT

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*Stable, geochemically mediated biospheres in the Deep Mine Microbial Observatory, SD, USA.* **M.R. Osburn**, C. Casar\*, B. Kruger, T. Flynn, Astrobiology Science Conference, April 2017, Mesa AZ

*Life underground at the deep mine microbial observatory,* **M.R. Osburn**, Rock-Hosted Life Workshop, Caltech, Feb 2017, Pasadena CA

*The energetic landscape of chemolithotrophy in the continental deep subsurface: sanford underground research facility (SURF), USA* **M.R. Osburn**, D.E. LaRowe, L.M. Momper, J.P. Amend, MicroEnergy Workshop, Sept 21-26 2015 Sanderberg, Denmark

*Lipid biomarkers of the deep terrestrial subsurface biosphere,* **M.R. Osburn**, F. Schubotz, L.M. Momper, B. Kiel-Reese, R.E. Summons, J.P. Amend, International Meeting of Organic Geochemists, Sept 14-18, 2015, Prague CZ

*Assessing microbial diversity of the subsurface using lipid structural variation and isotopic composition,* **M. Osburn**, Deep Carbon Observatory Early Career Workshop, September 3, 2015 Ponta Delgada Azores

*Distribution of lipid biomarkers along geochemical gradients in a deep subsurface environment.* **M.R. Osburn**, F. Schubotz, R. E. Summons, J. P. Amend, Astrobiology Science conference, June 15-19 2015, Chicago IL.

*Habitability of the Terrestrial Deep Subsurface: Sanford Underground Research Facility, South Dakota, USA.* **M.R. Osburn**, J.P. Amend, D.E. LaRowe, L.M. Momper, G.P. Wanger, B.K. Reese, M. Y. El-Naggar, R. Bhartia, V.J. Orphan, Y. Jangir, and D. Moser, Astrobiology Science Conference, June 15-19 2015, Chicago IL

*Lipid biomarkers of the terrestrial deep subsurface biosphere,* Fall meeting of the American Geophysical Union, December 14-19, 2014, San Francisco CA

*Life at SURF: Reaction energetics, microbiology, and intact polar lipid distributions,* NASA Astrobiology Institute "Life Underground" all hands meeting, September 15-16, 2014

### **Other presentations and abstracts:**

#### **2019**

*The VALKYRIE Payload for Probing the Martian Subsurface* M. Mischna, V. Stamenkovic, N. Lanza, R.E. Grimm, J.F. Mustard, V.J. Orphan, K.L. Rogers, K. Zacny, B. Sherwood Lollar, B. Menez, T. Spohn, Ana-Catalina Plesa, J. Michalski, and **M.R. Osburn**, Fall Meeting of the American Geophysical Union, December 2019, San Francisco, CA

*Diverse terrestrial evidence for Holocene temperature trends over Greenland: a view from beyond the ice sheet,* Y. Axford, M.L. Chipman\*, L. Larocca\*, G.E. Lasher\*, J.M. McFarlin\* and **M.R. Osburn**, Fall Meeting of the American Geophysical Union, December 2019, San Francisco, CA

*Greenland Ice Sheet mass loss during the Last Interglacial and middle Holocene despite paleolimnological evidence for increased atmospheric moisture,* J.M. McFarlin\*, Y. Axford, **M.R. Osburn**, A.L. Masterson and G.E. Lasher\*, Fall Meeting of the American Geophysical Union, December 2019, San Francisco, CA

*Microbial Succession in Hypersaline, Alkaline Mono Lake, CA* A. Phillips, D.R. Speth, L.G. Miller, F. Wu, X. T. Wang, D. Potocek, P.M. Medeiros, **M.R. Osburn**, H. Johnson, L. Trower, W. Berelson, A.J. West, W.W. Fischer, V.J. Orphan, H. Betts, A.L. Sessions and Geobiology

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Course 2017 & 2018, Fall Meeting of the American Geophysical Union, December 2019, San Francisco, CA

*Organic and isotopic biosignatures of lava tubes*, M.J. Selensky\*, M.R. Osburn, and J.G. Blank, Midwest Geobiology Symposium, October 2019, St. Louis, MO

*A stable strontium isotope record of pre-Sturtian carbonates spanning a large  $\delta^{13}\text{C}$  anomaly*, N.L. Sarvian\*, M.T. Hurtgen, A.D. Jacobson, A.C. Maloof, and M.R. Osburn, Midwest Geobiology Symposium, October 2019, St. Louis, MO

*Big data in geobiology: Applications to DeMMO*, C. Casar\* and M. Osburn, Midwest Geobiology Symposium, October 2019, St. Louis, MO

*The role of fluid residence time and colonization substrate in deep subsurface microbial community structure*, H.M. Sapers, R. Bhartia, G. Wanger, J.P. Amend, B. Kruger, C. Casar\*, **M. Osburn**, V.J. Orphan, Goldschmidt, August 2019, Barcelona, Spain.

*Following Carbon in Subsurface, Alkaline Spring Environments: Analogs for Icy Worlds in the Philippines*, D. Meyer-Dombard, D. Cardace, **M.R. Osburn**, Astrobiology Science Conference, June 2019, Seattle, WA

*NASA's BRAILLE Project: Results from the 2018 Field Campaign at Lava Beds National Monument (N. CA, USA)* J.G. Blank, A. Colaprete, T. Cohen, S. Datta, D.P. Moser, A.V. Nefian, D.E. Northup, **M.R. Osburn**, T.L. Roush, C. Stoker, U. Wong, The BRAILLE Team, Astrobiology Science Conference, June 2019, Seattle, WA

*Combining Geochemistry and Microbial Ecology to Understand Habitability and Processes in the Subsurface Terrestrial Biosphere*, L.M. Momper\*, C. Casar\*, B. Kruger, T.M. Flynn, **M.R. Osburn**, Astrobiology Science Conference, June 2019, Seattle, WA

*Life Underground: Investigations of the Terrestrial Subsurface Biosphere with an Eye Towards Extraterrestrial Planetary Bodies*, J. Amend, **M.R. Osburn**, R. Bhartia, M. El-Naggar, D.P. Moser, K.H. Nealson, B. Orcutt, V.J. Orphan, Astrobiology Science Conference, June 2019, Seattle, WA

*Organic Biosignatures in a Mars-Analog Lava Tube System, Lava Beds National Monument, CA*, M. Selensky\*, **M.R. Osburn**, J. Blank, Astrobiology Science Conference, June 2019, Seattle, WA

*Mineral-hosted biofilm communities in a deep subsurface Mars-analog system: The Deep Mine Microbial Observatory, SD, USA*, C. Casar\*, **M.R. Osburn**, T.M. Flynn, A.L. Masterson, B. Kruger, Astrobiology Science Conference, June 2019, Seattle, WA

*The Role of Ionic Composition and Concentration on Biosignature Preservation: Lessons from the "Spotted" Lakes of British Columbia*, A. Pontefract, C.E. Carr, **M.R. Osburn**, Astrobiology Science Conference, June 2019, Seattle, WA

### **2018**

*A calibration of hydrogen isotope ratios of sedimentary plant waxes as a proxy for meteoric water in the Arctic*. J.M. McFarlin, Y. Axford, A. Masterson, **M. R. Osburn**, Fall meeting of the American Geophysical Union, December 2018, Washington DC

*Spatial and Temporal Dynamics of Microbial Sulfur Cycling During the Onset of Meromixis in Mono Lake, California*, M.C. Figueroa, S.A. Parra, Q. Zhu, B. Conley, D. R. Speth, D.R. Monteverde, A. Phillips, L. Miller, A. Sessions, V. Orphan, W. Fischer, **M. Osburn**, 2018 International Geobiology Course Participants. Fall meeting of the American Geophysical Union, December 2018, Washington DC



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*An assessment of microbial mat and microbially influenced mineral age, carbon biogeochemistry, lipid profiles, and eukaryotic and prokaryotic community structure in lava caves to inform life detection targets.* B. Kruger, D. Moser, D. Northup, **M. Osburn**, J. Hathaway, M. Spilde, J. Blank, K. Papp. Fall meeting of the American Geophysical Union, December 2018, Washington DC

*Transformation of ancient organic carbon in exposed organic-rich black shale of the Monterey Formation, Naples Beach, CA.* C. Casar, A. Karbelkar, G. Vinnichenk, M. Chen, **M.R. Osburn**, V. Osburn, W.W. Fisher, A.L. Sessions., Fall meeting of the American Geophysical Union, December 2018, Washington DC

*Mineral-hosted biofilm communities in the continental deep subsurface.* C. P. Casar, **M. R. Osburn**, T. M. Flynn, A. L. Masterson, B. R. Kruger, International Society for Microbial Electrochemistry and Technology, September 2018, Minneapolis, MI

*Metabolic Potential and Activity in The Continental Deep Subsurface At The Sanford Underground Research Facility, South Dakota, USA.* J.P. Amend, **M.R. Osburn**, L.M. Momper, G.P. Fournier, C. Magnabosco, A.R. Rowe, K. Abuyen, J. Feyhl-Buska, International Symposium on Microbial Ecology, August 2018, Leipzig, Germany.

*Using DUV Raman and fluorescence spectroscopy to localize biomass and identify microbial activity.* Sapers, H. M., Bhartia, R., Amend, J., Kruger, B., Mullin, S., **Osburn M.**, Wanger, G., Orphan, V. J. International Symposium on Microbial Ecology, August 2018, Leipzig, Germany.

*Microbes, Minerals and Electrodes at the Sanford Underground Research Facility (SURF): Electrochemistry 4000 ft below the surface.* A. Rowe, K. Abuyen, B. Lam, C. Cesar, B. Kruger, **M. Osburn**, M. El-Naggar, J. Amend, American Society for Microbiology, June 2018, Atlanta GA

*Hydrogen isotope ratios of sedimentary plant lipids as a proxy for meteoric water in the Arctic.* J. M. McFarlin, Y. Axford, A. Masterson, **M. R. Osburn**, GRC Organic Geochemistry, June 2018, Holderness NH

*BRaille Field Campaign I: Astrobiology Instrument Testing And Science Sampling At Lava Beds National Monument (N. Ca, USA), A Planetary Caves Analog Site.* Blank, Battazzo, Bieler, Cohen, Colaprete, Datta, Deans, Hathaway, Ingham, Moser, Nefian, Northup, **Osburn**, Rogg, Roush, Stoker, Tardy, White, and Wong, Lunar and Planetary Science Conference, March 2018, Houston TX

*Potential Sources of Carbon in Terrestrial, Energy Limited Environments.* D.R. Meyer-Dombard, D. Cardace, C. Arcilla, **M. R. Osburn**, K.M. Woycheese, E.L. Shock, GRC Geobiology, January 2018, Galivston TX

*Life in the Continental Deep Subsurface: A Case Study at SURF, South Dakota.* J. Amend and **M.R. Osburn**, GRC Geobiology, January 2018, Galivston TX

### **2017**

*Cultivating the deep subsurface microbiome.* C.P. Casar\*, **M.R. Osburn**, T.M. Flynn, A.L. Masterson, B.B. Kruger, Fall meeting of the American Geophysical Union, December 2017, New Orleans LA

*A Compound-Specific Hydrogen Isotope Record at the Onset of Ocean Anoxic Event 2, Kaiparowitz Plateau, Southern Utah.* Todes, J.\*, Jones, M.M.\*, Sageman, B.B., Osburn, M.R. Fall meeting of the American Geophysical Union, December 2017, New Orleans LA

## **Curriculum Vitae** - Updated February 28<sup>th</sup>, 2020

*Genomic Evidence of Chemotrophic Metabolism in Deep-Dwelling Chloroflexi Conferred by Ancient Horizontal Gene Transfer Events*, L. Momper, C. Magnabosco, J. Amend, **M.R. Osburn**, G. Fournier. Fall meeting of the American Geophysical Union, December 2017, New Orleans LA

*Microbes, Minerals and Electrodes at the Sanford Underground Research Facility (SURF): Electrochemistry 4100 ft below the surface*, A.R. Rowe, K Abuyen, C. Casar\*, **M. Osburn**, B. Kruger, M. El-Naggar, J. Amend. Fall meeting of the American Geophysical Union, December 2017, New Orleans LA

*Microbes, Minerals and Electrodes at the Sanford Underground Research Facility (SURF): Electrochemistry 4100 ft below the surface*, A.R. Rowe, K Abuyen, C. Casar\*, **M. Osburn**, B. Kruger, M. El-Naggar, J. Amend. Fall meeting of the American Geophysical Union, December 2017, New Orleans LA

*Constraining Lipid Biomarker Paleoclimate Proxies in a Small Arctic Watershed*, H. Dion-Kirschner\*, J. McFarlin\*, Y. Axford, **M. Osburn**, Fall meeting of the American Geophysical Union, December 2017, New Orleans LA

*Sedimentary lipids as a paleoclimate proxy in Greenland*, McFarlin, J.M.\*, Osburn, M., Axford Y., Lasher G., Midwest Geobiology Symposium 2017, Indianapolis IN

*Cultivating the deep subsurface microbiome*, C.P. Casar\*, **M.R. Osburn**, T.M. Flynn, A.L. Masterson, B.B. Kruger, Astrobiology Science Conference, April 2017, Mesa AZ

### **2016**

*Iodine constraints on Proterozoic shallow ocean redox and their biological implications*, D.S. Hardisty, Z. Lu, A. Bekker, B.C. Gill, G. Jiang, L.C. Kah, A.H. Knoll, S.J. Loyd, **M.R. Osburn**, N.J. Planavsky, P.K. Swart, X. Zhou, C.W. Diamond, and T.W. Lyons. Gordon Conference on Geobiology 2016, Galveston TX

*Microbial diversity, electrode cultivation, and metabolism energetics in the continental deep subsurface*, J. Amend, **M. Osburn**, L. Momper, B. Reese, Y. Jangir, G. Wanger, B. Kruger, And M. El-Naggar. Goldschmidt Conference 2016 Yakohama Japan

*The carbonate clumped isotopic record of paired dolomite and calcite from the Sultanate of Oman*, K.D. Bergmann, J.P. Grotzinger, S. Al Balushi, **M. Osburn**, W.W. Fischer, J.M. Eiler, Dolomieu 2016, Italy

*Eemian and Holocene interglacial climate in northwest Greenland inferred from insect assemblages, lipid  $\delta^{2}H$ , and chitin  $\delta^{18}O$  preserved in lake sediments*, McFarlin, J.\*, Axford, Y., **Osburn, M.**, Lasher\*, G., Kelly, M., Osterberg, E., Francis, D., Farnsworth, L., Fall meeting of the American Geophysical Union, December 2016, San Francisco CA

### **2015**

*Holocene and last interglacial continental climate inferred from insects and n-alkanes in lake sediments from northwest Greenland*, Mcfarlin, J.\*, Axford, Y., **Osburn, M. R.**, Kelly, M.A., Osterberg, E. C., Lasher, G.E.\*, Farnsworth, L., and Francis, D.R, North-Central Section Geological Society of America Annual Meeting, May 19-20, 2015. Madison WI

*Correlating geochemistry and microbial community composition in the deep continental biosphere*, L.M. Momper, **M.R. Osburn**, and J.P. Amend, Astrobiology Science Conference, June 15-19, 2015, Chicago IL

*Surface ocean oxygenation coincident with the Late Neoproterozoic Shuram carbon isotope excursion and animal diversification*, D.S. Hardisty, Z. Lu, **M. R. Osburn**, S. Loyd, X. Zhou, G. Jiang, N. J. Planavsky, T. W. Lyons, Astrobiology Science Conference, June 15-19, 2015, Chicago IL

*Holocene temperature shifts around Greenland: Paleolimnological approaches to quantifying past warmth and documenting its consequences*, Y. Axford ... **M. Osburn**,

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et al., Fall Meeting of the American Geophysical Union Dec 13-18, 2015, San Francisco CA

*Lacustrine records of continental climate in northwest Greenland through the Holocene and Last Interglacial*, J. McFarlin\*, Y. Axford, **M. Osburn** et al., Fall Meeting of the American Geophysical Union Dec 13-18, 2015, San Francisco CA

\* Indicates a Northwestern student or post doc

### **Peer-Review and Related Activities**

#### *Manuscript Reviews for:*

- Nature Geoscience (2019 – present, 2 so far)
- The ISME Journal (2019 – present, 1 so far)
- Geology (2019 – present, 1 so far)
- Organic Geochemistry (2013 – present, 1 per year)
- Geobiology Journal (2014 – present, 0-1 per year)
- Frontiers in Microbiology (2014 – present, 2-4 year)
- Geochimica et Cosmochimica Acta (2014 – present, 2 per year)
- Environmental Microbiology (2014 – present, 1 per year)
- Chemical Geology (2016 – present, 1 per year)
- Biogeosciences (2016 – present, 1 per year)
- Rapid Communications in Mass spectrometry (2017, 1 so far).
- Additional reviews completed for: American Journal of Science (1), GeoArabia (1), FEMS microbiology letters (1), Nature Geoscience (1)

#### *Editorial boards:*

- Frontiers in Extreme Microbiology
- Geobiology

#### *Proposal Reviews:*

- NSF: Low temperature geochemistry and geobiology
- NASA: Exobiology
- NSF: Major Research and Instrumentation
- U.S. Army Corps of Engineer's

### **Professional Affiliations and Service**

*Professional Organizations:* American Geophysical Union (AGU), European Association of Organic Geochemists (EAOG), Geochemical Society (GS), Earth Science Women's Network (ESWN), Geobiology Society

#### *Professional Service:*

### **Conference Sessions and Themes:**

- Session Convener: Recognizing Preserved Microbial Signatures in Modern and Ancient Environments, Goldschmidt, June 21-26, 2020, Honolulu, HI.
- Session Convener: Earth 4D, A deep dive into the habitability of the blue planet. Fall Meeting of the American Geophysical Union Dec 9-13, 2019, San Francisco, CA.
- Symposium Convener: Midwest Geobiology Symposium, October 2018, Evanston, IL.

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- Theme Chair: of the Geobiology theme for the Goldschmidt Conference, Boston, August, 2018.
- Session Convener: *Unearthing the Metabolic Potential of Microorganisms in the Deep Subsurface Biosphere*, Fall Meeting of the American Geophysical Union Dec 10-15, 2017, New Orleans, LA.
- Session Convener: *Life detection lessons from analogue environments*, Astrobiology Science Conference, April 2017, Mesa AZ.
- Session Convener: *Advances in stable isotope geochemistry for understanding microbial ecosystems*, Fall Meeting of the American Geophysical Union Dec 13-18, 2015, San Francisco, CA.
- Session Convener: *Habitability of Extraterrestrial Analog Environments*, Magdalena Osburn, Astrobiology Science Conference, June 2015, Chicago IL.
- Session Convener: *Understanding microbial ecosystems using isotope geochemistry*, Fall meeting of the American Geophysical Union, December 2014, San Francisco, CA.
- Symposium Convener: Midwest Geobiology Symposium, September 2014, Chicago IL.

### **External Instruction:**

- Instructor, International Geobiology Course, Caltech, July 2020.
- Instructor, International Geobiology Course, Caltech, July 2019.
- Instructor, International Geobiology Course, Caltech and Catalina Island, July 2018.
- Instructor, International Geobiology Course, Caltech and Catalina Island, July 2017.
- Lecturer, International Geobiology Course, Catalina Island, July 2015.

### **Teaching and Advising**

#### *Course development and teaching:*

**Earth 490: Seminar Supercharged!** – (New Build) Fall 2019 – A graduate level seminar developed to increase the engagement of our graduate students in departmental seminars. During the course we would read and discuss a paper by the seminar speaker, attend seminar, and then meet with the speaker for additional questions and reflection.

**Earth 450: Special Topics in Geochemistry – Nitrogen Isotopes** – (New Build) A graduate level seminar focused on unwinding the complexities of the nitrogen cycle and the state-of-the-art literature on the isotopic fractionations associated with each process.

**Earth 204: Communication for Geoscientists** – (New Build) Winter 2018, 2019, 2020 – An undergraduate course aimed at teaching our majors scientific writing, reading, and presentation so they may be better prepared for careers in the geosciences.

**Earth 373: Microbial Ecology** – (New Build) Winter 2016, Spring 2018, Spring 2020 – An upper level undergraduate to graduate level course detailing aspects of microbial ecology including microbial physiology, microbial interaction types, syntrophy with plants and animals, and diversity of specific environments.

**Earth 370: Geobiology** – (New Build) Spring 2015, 2017, 2019 – An upper level undergraduate to graduate level course taught using a partially flipped, active learning-

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based method covering key players, biogeochemistry, and techniques of geobiology as well as a walk through the geobiology of Earth through time.

**Earth 331: Field Problems in Sedimentary Geology** – Fall 2014 – I co-caught this field and literature-based course with Brad Sageman. The course featured a three-week field trip to CO and UT and an extensive literature review. I specifically contributed knowledge on carbonate environments in the field and on use of Adobe Illustrator software in the lab.

### **Students**

*Undergraduates under my advisement:*

**Sohyun Lee** (Class of 2021)

**Annamarie Jedziniak** (Class of 2021)

**Caroline Webster** (Class of 2021)

**Kaila Christensen** (Class of 2021)

**Ari Sloss** (Class of 2023)

**Aida Zeleke** (Class of 2023)

*Undergraduate Lab Alumni:*

**Dana Johnson** (graduated with honors 2016, Ph.D. student at UW Madison)

**Jordan Todes** (graduated with honors 2018, Fulbright Scholar, Poland)

**Hannah Dion Kirschner** (graduated with honors 2018, Ph.D. student at Caltech)

**Bethany Ketchum** (graduated 2018, US Forest Service)

**Natalia Obrzut** (Loyola, graduated 2018, NU CEE graduate student)

**Jordan Foster** (Montana Tech, class of 2020)

*Graduate students under my advisement:*

**Caitlin Casar** (4<sup>nd</sup> year) – Caitlin works on aspects of the deep biosphere research ongoing in my laboratory. She is an active field participant at the SURF field site and is the primary user of the microbial cultivation laboratory.

**Matt Selensky** (2<sup>st</sup> year) – Matt will start of working on the microbiology and lipid production in lava tube environments.

**Nilou Sarvian** (3<sup>nd</sup> year) – I am on Nilou's committee and have been working with her on possible microbial fraction of Ca and Sr isotopes.

**Allie Wyman** (4<sup>rd</sup> year, University of Illinois Champagne-Urbana)- Allie has been conducting lipid biomarker work on lake sediments from the Christmas Islands in my laboratory. I am on her committee and sat for her qualifying exam.

**Floyd Nichols** (1<sup>st</sup> year) – Floyd is working on understanding biomarker production and preservation in hypersaline environments of western Canada

**Tim Coston** (1<sup>st</sup> year) – Tim is working jointly between me and Dr. Yarrow Axford investigating paleoclimatic changes in Greenland associated with the Younger Dryas.

*Lab Graduate Alumni:*

**Jamie McFarlin** (graduated 2019) – I coadvise Jamie with Yarrow Axford on the use of hydrogen isotope and lipid biomarker proxies in lake sediments to interpret the paleoclimate of Greenland.

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*Post-Doctoral Scholars:*

**Lily Momper** (2018-2019)

**Fabrizo Sabba** (2019 – present)

**Department, College, and University Service**

*Department of Earth and Planetary Science:*

- EPS Search Committee
  - Chair            2019 – 2020
  - Member        2018 – 2019
- Curriculum Committee
  - Chair            2016 - present
  - Member        2015 – 2016
- IRMS Laboratory Manager Search Committee
  - Chair            2015 – 2016
- Faculty Sponsor of the NU Geoclub 2015 – present

*Northwestern University:*

- Ad hoc member of Limited Submission Advisory Committee, 2019, 2020
- Finite Earth-Networking luncheon series – 2018