

CURRICULUM VITAE | MOLLY D. O'BEIRNE

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PROFESSIONAL APPOINTMENTS

2019 – present **Postdoctoral Scholar – Department of Earth Science**
University of California Santa Barbara (UCSB); Santa Barbara, CA, USA
Advisor: Dr. Morgan R. Raven

EDUCATION

2013 – 2018 **PhD - Geology & Environmental Science**
University of Pittsburgh (PITT); Pittsburgh, PA, USA
Advisor: Dr. Josef P. Werne
Dissertation: *“Structure and Stable Isotopic Biogeochemistry of Organic Sulfur in the Geosphere: Application of Bulk and Compound-Specific Sulfur Isotope Analysis to Modern and Ancient Euxinic Systems”*

2011 – 2013 **MS - Water Resources Science**
University of Minnesota – Duluth (UMD); Duluth, MN, USA
Concentration: Limnology and Oceanography
Advisor: Dr. Josef P. Werne
Thesis: *“Anthropogenic climate change has driven Lake Superior productivity beyond the range of Holocene variability: An organic and stable isotopic study of human impacts on a pristine biogeochemical system”*

2006 – 2009 **BS - Chemistry**
Bemidji State University (BSU); Bemidji, MN, USA
Concentration: Biochemistry
Minor: Biology
Honor graduate: Magna Cum Laude

RESEARCH INTERESTS

Organic and stable isotopic biogeochemistry, global biogeochemical cycles, sulfur biogeochemistry, nutrient cycling, (paleo)limnology, (paleo)oceanography, geomicrobiology, microbial geochemistry, exobiology, planetary habitability

PROFESSIONAL EXPERIENCE

Research:

2018 **Planetary Science Researcher - NASA Frontier Development Lab (NASA FDL), NASA Ames, SETI Institute & Google Cloud, Mountain View, California**

- *8-week Summer Challenge: Astrobiology Team II* – “From biohints to confirmed evidence of life: possible metabolisms within extraterrestrial environmental substrates”
- Part of the Astrobiology Team that (1) generated a data set of 3,000,000 terrestrial exoplanet atmospheric spectra, (2) developed a machine learning framework for terrestrial exoplanet

atmospheric retrievals – with future applications for telescope design and determining signs of life “biohints” on exoplanets.

- Received the NASA FDL 2018 Collaborative Spirit Award

- 2017 **Visiting Scholar** - *University of Manchester, School of Earth & Environmental Sciences, Manchester, UK; Supervisor: Dr. Bart E. van Dongen*
- 3 weeks
 - Offline pyrolysis of kerogens
 - Online pyrolysis mass spectrometry (py-GC/MS) of kerogens and laboratory sulfurized substrates
 - FTIR spectroscopic analysis of kerogens and laboratory sulfurized substrates
- 2016 – 2018 **Visiting Scholar** - *California Institute of Technology (Caltech), Division of Geological & Planetary Sciences, Pasadena, CA, USA; Supervisor: Dr. Alex L. Sessions*
- 2016 (2 weeks); 2017 (5 weeks); 2018 (2 weeks)
 - Compound-specific sulfur isotope analysis via GC-MC-ICP-MS
- 2016 **Visiting Scholar** - *Indiana University-Purdue University Indianapolis (IUPUI), Department of Earth Sciences, Indianapolis, IN, USA; Supervisor: Dr. William P. Gilhooly III*
- 2 weeks
 - Acid volatile sulfur (AVS) and chromium reducible sulfur (CRS) extractions
 - Analysis of samples (AVS & CRS) via UV/VIS spectroscopy for sulfur concentration measurements
 - Preparation of samples (AVS, CRS, and total organic sulfur – TOS) for bulk sulfur isotope analysis via EA-IRMS
- 2013 – 2018 **Graduate Research Assistant - Graduate Assistant to the Lab Manager, PITT – Department of Geology & Environmental Science; Werne Lab (Organic Geochemistry)**
- Preparation and analysis of bulk sediment samples via EA-IRMS (carbon, nitrogen)
 - Extraction of sediment samples for total lipids (ASE, Soxhlet, Sonic, Bligh & Dyer)
 - Laboratory method development and procedure optimization
 - Instrument method development and troubleshooting (GC-FID/FPD and GC-MSD)
 - Quantification and identification of organic compounds via GC-FID/FPD and GC-MSD
 - Compound-specific isotope analysis via GC-C-IRMS (carbon, hydrogen)
 - Data analysis using Xcaliber, Isodat, Chromeleon, Excel and SigmaPlot
- 2011 – 2013 **Graduate Research Assistant, UMD - Large Lakes Observatory (LLO); Werne Lab (Organic Geochemistry)**
- Preparation and analysis of bulk sediment samples via EA-IRMS (carbon, nitrogen)
 - Extraction of sediment samples for total lipids (ASE, Soxhlet, Sonic, Bligh & Dyer)
 - Standard wet chemistry techniques (e.g. column chromatography, solid phase extraction, compound derivatization)
 - Quantification and identification of organic compounds via GC-FID/FPD and GC-MSD
 - Compound-specific isotope analysis via GC-C-IRMS (carbon)
 - Data analysis using ChemStation, Isodat, Excel and SigmaPlot
- Teaching:*
- 2018 **Invited Lecturer, Chatham University – Falk School of Sustainability & Environment;** Environmental Geology (ENV 247; undergraduate course). Lecture topic: Anthropogenic climate change: causes and effects.
- 2018 **Invited Lecturer, PITT – Department of Geology & Environmental Science;** Organic and Stable Isotope Geochemistry (GEOL 2501; graduate course). Lecture topic: environmental applications of stable isotope analysis.

- 2017 **Invited Lecturer**, PITT – Department of Geology & Environmental Science; Aquatic and Sedimentary Geochemistry (GEOL 2510; graduate course). Lecture topics: dissolved gases, dissolved inorganic carbon, and stable isotope fundamentals.
- 2013 – 2018 **Teaching Fellow**, PITT – Department of Geology & Environmental Science; Intro. Geology (GEOL 0055; 0800) lab and recitation sections; Geology of the National Parks (GEOL 0802) recitation sections; The Atmosphere, Oceans, and Climate (GEOL 1030) recitation sections (undergraduate courses)
- 2012 – 2013 **Graduate Teaching Assistant**, UMD – Department of Chemistry & Biochemistry; General Chemistry II (CHEM 1152) lab and recitation sections (undergraduate course)

GRANTS, FELLOWSHIPS, AWARDS & HONORS

- 2018 NASA FDL – Collaborative Spirit Award (Astrobiology Team II)
- 2018 PITT – Kenneth P. Dietrich School of Arts and Sciences academic honoree
- 2017 PITT – Graduate Student Organization Summer Research Grant
- 2017 EAOG – European Association of Organic Geochemists Travel Scholarship
- 2017 PITT – Provost Development Fund Award - Predoctoral Fellowship (2017-2018 academic year)
- 2017 PITT – Henry Leighton Memorial Graduate Award
- 2016 PITT – Graduate Student Organization Travel Scholarship
- 2015 PITT – Andrew Mellon Predoctoral Fellowship (2015-2016 academic year)
- 2014 NSF Low Temperature Geochemistry & Geobiology to (P.I.) Werne and (Co-I.) Gilhooly; O’Beirne co-wrote to support PhD research (as non-P.I.)
- 2012 UMD – Water Resources Science Travel Grant recipient; GRC – organic geochemistry
- 2012 UMD – Water Resources Science Summer Fellowship
- 2009 BSU – Chemistry Department Harold T. Peters Memorial Scholarship
- 2008 BSU – Chemistry Department Henderson, Patton, Jones Memorial Scholarship
- 2006 – 2008 BSU – President’s Citation for earning a 4.0 GPA
- 2005 – 2009 Marshall H. and Nellie Alworth Memorial Fund Scholarship
- 2005 – 2006 UMD – Swenson Family Foundation Scholarship

PAPERS IN REFEREED JOURNALS

- [6] O’Beirne, M.D., Werne, J.P., Elliott, E.M., Hecky, R.E., Katsev, S., Reavie, E.D. (2019). Sedimentary nitrogen isotopes in Lake Superior record changes in nitrogen sources and cycling over the last century. *Limnology & Oceanography*. (submitted)
- [5] Kireta, A.R., Chraïbi, V.L.S., O’Beirne, M.D., Werne, J.P., Saros, J.E. (2019). Comparison of sedimentary diatom profiles during the Medieval Climate Anomaly and the 20th century in Lake Superior suggests recent changes are unique. *Journal of Paleolimnology*. (submitted)
- [4] Cobb, A.D., Himes, M.D., Soboczenski, F., Zorzan, S., O’Beirne, M.D., Baydin, A.G., Gal, Y., Domagal-Goldman, S.D., Arney, G.N., Angerhausen, D. (2019). An Ensemble of Bayesian Neural Networks for Exoplanetary Atmospheric Retrieval. *The Astrophysical Journal*. (submitted)
- [3] Kurek, M.R., Gilhooly, W.P., Druschel, G.K., O’Beirne, M.D., Werne, J.P. (2018). The use of dithiothreitol for the quantitative analysis of elemental sulfur concentrations and isotopes in environmental samples. *Chemical Geology*. doi: 10.1016/j.chemgeo.2018.01.014
- [2] O’Beirne, M.D., Werne, J.P., Hecky, R.E., Johnson, T.C., Katsev, S., Reavie, E.D. (2017). Anthropogenic climate change has altered Lake Superior productivity. *Nature Communications*. doi: 10.1038/ncomms15713

[2a] Open access, adapted version of article for high school students (including teaching resources): How does climate change affect the Great Lakes? *Science Journal for Kids*. <http://www.sciencejournalforkids.org/science-articles/how-does-climate-change-affect-the-great-lakes>

[1] O'Beirne, M.D., Strzok, L., Werne, J.P., Hecky, R.E., Johnson, T.C. (2015). Anthropogenic impacts on the sedimentary geochemical record of western Lake Superior (1800-present). *Journal of Great Lakes Research*. doi: 10.1016/j.jglr.2014.11.005

CONFERENCE PROCEEDINGS

Invited Talks:

- 2019 TBD. *NASA Goddard Space Flight Center*. Washington, D.C., USA.
- 2019 INARA: Intelligent exoplaNet Atmospheric Retrieval - A Machine Learning Retrieval Framework with a Data Set of 3 Million Simulated Exoplanet Atmospheric Spectra. *Astrobiology Science Conference (AbSciCon)*. Seattle, WA, USA.
- 2019 Bayesian Deep Learning for Exoplanet Atmospheric Retrieval. *Google Cloud Next '19*. San Francisco, CA, USA.
- 2017 Anthropogenic impacts on Lake Superior. *University of Pittsburgh - Science 2017*. Pittsburgh, PA, USA.

Selected Abstracts (first author only):

- 2017 O'Beirne, M.D., Werne, J.P., van Dongen, B.E., Gilhooly, W.P. An Experimental Study of Low-Temperature Sulfurization of Carbohydrates Using Various Sulfides Reveals Insights into Structural Characteristics and Sulfur Isotope Compositions of Macromolecular Organic Matter in the Environment. *American Geophysical Union (AGU)*. New Orleans, Louisiana, USA. (oral presentation)
- 2017 O'Beirne, M.D., Werne, J.P., Hecky, R.E., Johnson, T.C., Katsev, S., Reavie, E.D. Lake Superior Sediments Record Anthropogenic Nitrogen Deposition. *Midwest Geobiology Symposium (MWGB)*, Indianapolis, Indiana, USA. (poster presentation)
- 2016 O'Beirne, M.D., Werne, J.P., Gilhooly, W.P., Fouskas, F., Sessions, A.L. Elucidation of the Timing and Formation Pathway(s) of Organic Sulfur Compounds in Two Modern Euxinic Systems Using Compound Specific Sulfur Isotope Analysis (CSSIA). *American Geophysical Union (AGU)*, San Francisco, California, USA. (poster presentation)
- 2016 O'Beirne, M.D., Werne, J.P., Gilhooly, W.P., Fouskas, F., Sessions, A.L. Compound Specific Sulfur Isotope Analysis (CSSIA) – implications for the timing and formation of organic sulfur compounds from a modern euxinic system. *Midwest Geobiology Symposium (MWGB)*, Cincinnati, Ohio, USA. (poster presentation)
- 2016 O'Beirne, M.D., Werne, J.P., Gilhooly, W.P., Fouskas, F., Sessions, A.L. Compound Specific Sulfur Isotope Analysis (CSSIA) – implications for the timing and formation of organic sulfur compounds and (paleo)environmental connections from a modern euxinic system. *Gordon Research Conference on Organic Geochemistry*, Holderness, New Hampshire, USA. (poster presentation)
- 2015 O'Beirne, M.D., Werne, J.P., Gilhooly, W.P., Harris, J., Fouskas, F. Refining gas chromatography techniques for the determination of inorganic polysulfide speciation – analysis and application to artificial and natural samples. *Midwest Geobiology Symposium (MWGB)*, Bloomington, Indiana, USA. (poster presentation)
- 2013 O'Beirne, M.D., Werne, J.P., Hecky, R.E., Johnson, T.C., Katsev, S., Reavie, E.D. Anthropogenic climate change has driven Lake Superior productivity beyond Holocene variability. *American Geophysical Union (AGU)*. San Francisco, California, USA. (poster presentation)
- 2012 O'Beirne, M.D., Werne, J.P., Hecky, R.E., Johnson, T.C., Katsev, S. Reconstruction of postglacial paleoproductivity in Lake Superior – placing recent changes in a historical context. *Gordon Research Conference on Organic Geochemistry*, Holderness, New Hampshire, USA. (poster presentation)

FIELD WORK

- 2017 Mahoney Lake (sediment coring and water column sampling; 2 weeks), British Columbia, Canada
- 2016 Fayetteville Green Lake – R/V Continental Drifter (in-situ water column filtration; 3 days), New York, USA

- 2015 Mahoney Lake (sediment coring and water column sampling; 2 weeks), British Columbia, Canada
- 2015 Fayetteville Green Lake (sediment coring and water column sampling; 2 weeks), New York, USA
- 2013 Lake Superior – R/V Blue Heron (sediment coring and seismic survey; day cruise), Minnesota, USA
- 2012 Lake Superior – R/V Blue Heron (water column sampling; day cruise), Minnesota, USA
- 2011 Island Lake Reservoir (water column sampling; weekly sampling over 3 months), Minnesota, USA
- 2011 Lake Superior – R/V Blue Heron (MN DNR fish trawling; 7-day cruise), Minnesota, USA

SYMPOSIA & SYNERGISTIC ACTIVITIES

Conference session chair:

- 2017 *Biogeochemistry & Geobiology of Anoxic/Euxinic Systems*. Geological Society of America (GSA) - NE & NC joint meeting, Pittsburgh, Pennsylvania, USA

Peer Review:

- 2018 – present Chemical Geology
- 2017 – present Organic Geochemistry
- 2016 – present *Geochimica et Cosmochimica Acta*

MENTORING & OUTREACH

Mentoring:

Graduate Students:

Dervla Kumar (MS 2017); Thesis: *“Production of Heterocyst Glycolipids and Glycerol Dialkyl Glycerol Tetraether membrane lipids in the water column of a stratified tropical lake, Malawi, Africa”*

Troy M. Ferland (MS 2017); Thesis: *“An Evaluation of the Organic Geochemical Potential to Reconstruct Mid-Pleistocene Paleoclimate Adjacent to an Established Hominin Site: Lake Magadi, Kenya”*

Undergraduate Students:

John Coyne (2017 – 2018): research topic *“Color analysis of a 10,000-yr sediment core from a modern euxinic lake – utility for paleoenvironmental reconstruction”*

Christina Puhnaty (2016): research involving organic synthesis and optimization of (poly)sulfide detection and speciation using gas chromatography

Tyler Myers (2015-2016): research involving compound specific carbon and hydrogen isotopes of fatty acids; fieldwork experience Fayetteville Green Lake

Evan Scott (2015): research involving compound specific carbon and hydrogen isotopes of fatty acids

Outreach:

2015 – 2016 **Graduate Student Teaching Mentor**; *PITT – Department of Geology & Environmental Science* – aided graduate and undergraduate teaching assistants with teaching responsibilities, student-teacher interactions, and organized teaching development seminars

2013 **R/V Blue Heron Science Friday Guide**; *LLO/UMD* – educational tour guide of the Research Vessel Blue Heron, including shipboard equipment demonstrations, for students (elementary through graduate) and the general public

2007 – 2009 **Vice President - Society of Geology and Environmental Geoscience**; *BSU* - development and volunteer of outreach and educational programs for area middle schools

PROFESSIONAL AFFILIATIONS

- 2019 – present The Association for the Sciences of Limnology and Oceanography (ASLO)
- 2015 – present Geological Society of America (GSA)
- 2013 – present American Geophysical Union (AGU)