

KATHERINE R HEAL (SHE/HER)

School of Oceanography
University of Washington
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EDUCATION

- 2018 **PhD in Chemical Oceanography**
University of Washington. Advisor: Dr. Anitra Ingalls
Thesis: The power and promise of direct measurements of metabolites in marine systems
- 2014 **MS in Chemical Oceanography**
University of Washington. Advisors: Dr. Anitra Ingalls and Dr. Allan Devol
Thesis: Sources, distributions, and consequences of cobalamin (vitamin B₁₂) in the marine environment revealed through liquid chromatography mass spectrometry
- 2011 **BA in Environmental Chemistry** *cum laude* with distinction
The Colorado College. Advisor: Dr. Sally Meyer
Thesis: A novel method for preconcentrating marine dissolved organic phosphorus: Lab development and application in the South Pacific

RESEARCH EXPERIENCE

- 2019-present **Simons Foundation Postdoctoral Fellow in Marine Ecology**
University of Washington. Advisor: Dr. Randelle Bundy
- 2011-2018 **Graduate Research Fellow**
University of Washington. Advisors: Dr. Anitra Ingalls and Dr. Allan Devol
- 2010-2011 **Summer Student Fellow and Visiting Scientist**
Woods Hole Oceanographic Institution. Advisor: Dr. Daniel Repeta
- 2009-2010 **Science Undergraduate Laboratory Intern**
Oak Ridge National Laboratory. Advisor: Dr. Melanie Mayes

PEER REVIEWED PUBLICATIONS (15 total, 5 as first or co-first author)

- 2020 Dawson, H.M., **Heal, K.R.**, Torstensson, A., Carlson, L.T., Ingalls, A.E., Young, J.N. Large diversity in nitrogen- and sulfur-containing compatible solute profiles in polar and temperate diatoms. *Integrative and Comparative Biology*. In press.
DOI: 10.1063/icb/icaa133
- 2020 Dawson, H.M., **Heal, K.R.**, Boysen, A.K., Carlson, L.T., Ingalls, A.E., Young, J.N., Characterization of compatible solute use in a cultured sea-ice alga, *Nitzschia lecointei*, and in the environmental algal community of Utqiagvik, AK using a metabolomics approach. *Elementa*. 8, 25.

- 2020 Lu, X., **Heal, K.R.**, Ingalls, A.E., Doxey, A.C., Neufeld, J.D. Metagenomic and chemical evidence for cobalamin-based microbial niches across diverse soil biomes. *ISME Journal*. 14, 53–66
- 2019 **Heal, K.R.**, Kellogg, N.A., Carlson, L.T., Lionheart, R., Ingalls, A.E. Metabolic consequences of cobalamin scarcity in diatoms as revealed through metabolomics. *Protist*. 3, 328–348.
- 2019 Durham, B.P., Boysen A.K., Carlson, L.T., Groussman, R.D., **Heal, K.R.**, Cain, K.R., Coesel, S., Morales, R.L., Morris, R. M., Ingalls, A.E., Armbrust, E.V. Sulfonate-based networks between eukaryotic phytoplankton and heterotrophic bacteria in the surface ocean. *Nature Microbiology*. 4, 1706–1715.
- 2018 **Heal, K.R.***, Qin, W.*, Amin, S.A., Armbrust, E.V., Devol, A.H., Moffett, J.W., Stahl, D.A., Ingalls, A.E. Unexpected accumulation of NO₂-cobalamin in ammonia-oxidizing archaea and in the oxygen deficient zone of the Eastern Tropical North Pacific. *Environmental Microbiology Reports*. 2018, 10. ***equal contribution.**
- 2018 Boysen A.K.*, **Heal, K.R.***, Carlson, L.T., Ingalls A.E. Best-matched internal standard normalization in liquid chromatography-mass spectrometry as applied to environmental metabolomics. *Analytical Chemistry*. 2018, 90. ***equal contribution.**
- 2018 Horak, R.E.A., Qin, W., Bertagnolli, A.D., Nelson, A., **Heal, K.R.**, Han, H., Heller, M., Schauer, A., Jeffrey, W., Armbrust, E.V., Moffett, J.W., Ingalls A.E., Stahl, D.A., Devol, A.H. Relative impacts of light, temperature, and reactive oxygen on thaumarchaeal ammonia oxidation in the North Pacific Ocean. *Limnology and Oceanography*. 2018, 63.
- 2017 Qin, W., **Heal, K.R.**, Ramdasi, R., Kobelt, J., Martens-Habben, W., Bertagnolli, A.D., Amin, S.A., Walker, C.B., Urakawa, H., Konneke, M., Devol, A.H., Moffett, J.W., Armbrust, E.V., Jensen, G.J., Ingalls A.E., Stahl, D.A. *Nitrosopumilus maritimus* gen. nov., sp. nov., *Nitrosopumilus cobalaminogenes* gen. nov., sp. nov., *Nitrosopumilus oxycliniae* gen. nov., sp. nov., and *Nitrosopumilus ureaphilus* gen. nov., sp. nov., four marine ammonia-oxidizing archaea of the phylum *Thaumarchaeota*. *International Journal of Systematic and Evolutionary Microbiology*. 2017, 12.
- 2017 Qin, W., Amin, S.A., Lundeen, R.A., **Heal, K.R.**, Martens-Habben, W., Turkarslan S., Urakawa, H., Costa, K.C., Hendrickson, E.L., Wang, T., Beck, D.A.C., Tequia, S.M., Taub, F., Holmes, A.D., Vajjala, N., Berube, P.M., T.M., Moffett, J.W., Devol, A.H., Baliga, N.S., Arp, D.J., Sayavedra-Soto, Hackett, M., Armbrust, E.V., Ingalls, A.E., Stahl, D.A. Stress response analyses of a marine ammonia-oxidizing archaeon informs physiological status of environmental populations. *ISME Journal*. 2017, 12.
- 2017 **Heal, K.R.**, Qin, W., Ribalet, F., Bertagnolli, A.D., Coyotes-Maetstas, W., Hmelo, L.R., Moffett, J.W., Devol, A.H., Armbrust, E.V., Stahl, D.A., Ingalls, A.E. Two distinct pools of B₁₂ analogs reveal community interdependencies in the ocean. *Proceedings of the National Academy of*

- Sciences*. 2017, 114.
- 2015 Amin, S.A., Hmelo, L.R., van Tol, H.M., Durham, B.P., Carlson, L.T., **Heal, K.R.**, Morales, R.L., Berthiaume, C.T., Parker, M.S., Djunaedi, B., Ingalls, A.E., Parsek, M.R, Moran, M.A., Armbrust, E.V. Interaction and signalling between a cosmopolitan phytoplankton and associated bacteria. *Nature*. 2015, 98.
- 2014 **Heal, K.R.**, Carlson, L.T., Devol, A.H., Armbrust, E.V., Moffett, J.W., Stahl, D.A., Ingalls, A.E. Determination of four forms of vitamin B₁₂ and other B vitamins in seawater by liquid chromatography/tandem mass spectrometry. *Rapid Communications in Mass Spectrometry*. 2014, 28.
- 2013 Martin, M.Z., Mayes M.A., **Heal, K.R.**, Brice, D.J., Wulfschleger, S.D. Investigation of laser-induced breakdown spectroscopy and multivariate analysis for differentiating inorganic and organic C in a variety of soils. *Spectrochimica Acta Part B*. 2013, 87.
- 2012 Mayes, M.A., **Heal, K.R.**, Brandt, C.C., Phillips, J.R, Jardine, P.M. Relation between soil order and sorption of dissolved organic carbon in temperate subsoils. *Soil Science Society of America Journal*. 2012, 76.

SUBMITTED MANUSCRIPTS

- In Review **Heal, K.R.**, Durham, B.P., Boysen, A.K., Carlson, L.T., Qin, W., Ribalet, F., White, A.E., Bundy, R.M., Armbrust, E.V., Ingalls, A.E. Marine community metabolomes carry fingerprints of phytoplankton community composition. bioRxiv doi: 10.1101/2020.12.22.424086
- In Review Biller, S.J., Lundeen, R.A., Hmelo, L.R., Becker, K.W., Arellano, A., Dooley, K., Carlson, L.T., **Heal, K.R.**, Van Mooy, B.A.S., Ingalls, A.E., Chisholm, S. *Prochlorococcus* extracellular vesicles: Molecular composition and adsorption to diverse microbes. bioRxiv doi: 10.1101/2020.12.18.423521
- In Revision Boysen, A.K., Carlson, L.T., Durham, B.P., Groussman, R.D., Aylward, F.O., Ribalet, F., **Heal, K.R.**, DeLong, E.F., Armbrust, E.V., Ingalls, A.E. Diel oscillations of particulate metabolites reflect synchronized microbial activity in the North Pacific Subtropical Gyre. bioRxiv doi: 10.1101/2020.05.09.086173v1

MANUSCRIPTS IN PREPARATION

- In Prep **Heal, K.R.**, Maloney, A., Ingalls, A.E., Bundy, R.M. Characterization of particulate organic arsenic in the open ocean.

OTHER PUBLICATIONS

- 2020 **Heal, K.R.** "Biological Pump" Climate Science for the Classroom, edited by Bertram and Biyani. <https://uw.pressbooks.pub/climate/chapter/biological-pump/>
- 2018 **Heal, K.R.** The power and promise of direct measurements of metabolites in marine systems. *Doctoral dissertation*.

TEACHING EXPERIENCE

- 2019 **Workshop leader**
Untargeted LC-MS Data Analysis Workshop
University of Washington
- 2019 **Co-Instructor of Record**
Ocean 295: Chemistry of Marine Organic Carbon
University of Washington
- 2019 **Guest Lecturer**
Ocean 522: Marine Organic Geochemistry (lipidomics unit)
University of Washington
- 2015 **Teaching Assistant (Curriculum development and implementation)**
Ocean 295: Chemistry of Marine Organic Carbon
University of Washington
- 2013-2014 **Curriculum development and guest teacher**
AP Environmental Science 3-day unit on Marine Carbon Pump
Inglemoor High School (Bothell, WA) and Sehome High School (Bellingham, WA).
- 2013 **Teaching Assistant**
Ocean 400: Chemical Oceanography
University of Washington
- 2008-2011 **Learning Assistant**
CHEM 107: General Chemistry I
CHEM 109: General Chemistry II
CHEM 204: Foundational Concepts in Organic Chemistry
ENV 431: Atmospheric Physics and Chemistry
ENV 211: Human Impacts on Biogeochemical Cycles
The Colorado College
- 2008-2011 **Drop in tutor**
Quantitative Reasoning Center
The Colorado College

FELLOWSHIPS AND GRANTS

- 2018 **Postdoctoral Fellowship in Marine Microbial Ecology** (\$261,000). *Simons Foundation*
- 2016 **Travel Grant** to attend Ocean Science Meeting (\$500). *College of the Environment, University of Washington*
- 2012 **Program Climate Change Graduate Fellowship** (1 yr tuition and stipend). *University of Washington*
- 2012 **Graduate Research Fellowship** (3 yr tuition and stipend). *National Science Foundation*
- 2012 **Collaborative Research Travel Grant** (\$5,000). *Burroughs Wellcome Fund*
- 2011 **Top Scholar – Egtvedt Grad Fellowship** (1 yr tuition and stipend).
University of Washington

- 2011 **Travel Grant** to attend American Society of Limnology and Oceanography annual meeting. *National Science Foundation Research Experience for Undergraduates*
- 2010 **Guest Student Honorarium** (\$1,000). *Woods Hole Oceanographic Institution*
- 2010 **Science and Energy Research Challenge Winner** (\$2,000). *Department of Energy Office of Science*
- 2010 **Venture Grant** (\$1,000). *The Colorado College*
- 2010 **Marine Physical Lab Summer Fellowship** (declined). *Scripps Oceanographic Institution*
- 2006-2008 **Iron Range Scholarship** (\$4,000 per yr). *The University of Minnesota*

AWARDS AND HONORS

- 2020 **Early Career Publication Honoree.** *Limnology and Oceanography*
- 2019 **Selected Participant.** Early Career Chief Scientist Training Program, *UNOLS*
- 2018 **Selected Participant.** Dissertations Symposium in Chemical Oceanography XXVI
- 2017 **College of the Environment Graduate Dean's Medalist.** *University of Washington*
- 2011 **Graduate Research Fellowship Honorable Mention.** *National Science Foundation*

INVITED PRESENTATIONS

- 2020 **Heal, K.R.,** Durham, B.P., Boysen, A.K., Carlson, L.T., Groussman, R., Bundy, R., Armbrust, E.V., Ingalls, A.E. Patterns in metabolite pools show that phytoplankton leave a taxon-specific signature on labile carbon in the surface ocean. Marine Chemistry and Geochemistry seminar, Woods Hole Oceanographic Institute. Remote seminar.
- 2019 **Heal, K.R.** Evidence and implications of arsenic removal from the surface ocean via complex biomolecules. Seminar at University of Rhode Island Graduate School of Oceanography. Narragansett, Rhode Island.
- 2018 **Heal, K.R.,** Carlson, L.T., Boysen, A.K., Durham, B.P., Groussman, R., Armbrust, E.V., Ingalls, A.E. New insights into microbial carbon exchange through metabolomics. Environmental Geology and Geochemistry Seminar at Princeton University. Princeton, New Jersey.
- 2018 **Heal, K.R.** Power and promise of direct measurements of metabolites in marine systems. Oral presentation at Dissertations Symposium in Chemical Oceanography XXVI. Kona, Hawai'i.
- 2017 **Heal, K.R.,** Qin, W., Ribalet, F., Bertagnolli, A.D., Amin, S., Coyotes-Maetstas, W., Hmelo, L.R., Moffett, J.W., Devol, A.H., Armbrust, E.V., Stahl, D.A., Ingalls, A.E. Insights into the sources and metabolic underpinnings of vitamin B₁₂ in the ocean as revealed through liquid-chromatography mass spectrometry. Oral presentation at Gordon

SELECTED ADDITIONAL PRESENTATIONS (* = undergraduate mentee)

- 2020 **Heal, K.R.**, Boysen, A.K., Durham, B.P., Carlson, L.T., Armbrust, E.V., Ingalls, A.E., Bundy, R.M. Chemical and genetic evidence point to arseno-metabolites underpinning the marine arsenic cycle. Oral presentation at Ocean Sciences Meeting. San Diego, CA.
- 2019 **Heal, K.R.**, Carlson, L.T., Boysen, A.K., Durham, B.P., Groussman, R.G., Armbrust, E.V., Ingalls, A.E. Environmental metabolomics across natural oceanographic gradients expose under-appreciated compounds engaged in multiple elemental cycles. Oral presentation at American Society of Limnology and Oceanography in San Juan, PR.
- 2018 **Heal, K.R.**, Carlson, L.T., Boysen, A.K., Durham, B.P., Kellogg*, A.K., Lionheart*, R.M., Armbrust, E.V., Ingalls, A.E. Metabolite pools across a basin-wide oceanographic gradient in the North Pacific. Poster presentation at Ocean Sciences Meeting. Portland, OR.
- 2017 **Heal, K.R.**, Carlson, L.T., Boysen, A.K., Lionheart*, R.M., Kellogg*, N.A., Ingalls, A.E. Metabolic consequences of cobalamin starvation in marine microbes revealed through metabolomics. Oral presentation at American Society of Limnology and Oceanography in Honolulu, HI.
- 2016 **Heal, K.R.**, Qin, W., Ribalet, F., Bertagnolli, A.D., Coyotes-Maetstas*, W., Hmelo, L.R., Moffett, J.W., Devol, A.H., Armbrust, E.V., Stahl, D.A., Ingalls, A.E. Cobalamin and cobalamin-like compounds in the sunlit ocean: Inter-phyla mutualism or competition? Oral presentation at Ocean Science Meeting in New Orleans, LA.
- 2015 **Heal, K.R.**, Coyotes-Maetstas*, W., Armbrust, E.V., Stahl, D.A., Devol, A.H., Moffett, J.W., Ingalls, A.E. Using targeted metabolomics to assess cobalamin demand in simple and natural marine systems. Poster presentation at Gordon Conference in Chemical Oceanography, NH.
- 2014 **Heal, K.R.** L. Truxal Carlson, W. Coyote-Maestas*, D.A. Stahl, W. Qin, E. V. Armbrust, J. Moffet, A. Devol, and A. E. Ingalls. Microbial contribution to the dissolved B₁₂ pool in coastal Washington. Poster presentation at Ocean Science Meeting in Honolulu, HI.
- 2014 Coyote-Maestas*, W., **Heal, K.R.** L. Truxal Carlson, D.A. Stahl, W. Qin, E. V. Armbrust, J. Moffet, A. Devol, and A. E. Ingalls. A quantitative analysis and comparison of B₇ and several forms of B₁₂ between coastal, sub arctic gyre and oligotrophic gyre regimes. Poster presentation at Ocean Science Meeting in Honolulu, HI.
- 2013 **Heal, K.R.** Embracing social media to teach introductory oceanography. Poster presentation at American Society of Limnology and Oceanography in New Orleans, LA.
- 2010 **Heal, K.R.**, Mayes, M., Phillips, J. Sorption of dissolved organic carbon onto subsurface soil. Oral presentation at Goldschmidt Geochemistry conference in

Knoxville, TN.

MENTORSHIP EXPERIENCE

- 2020-present **Thesis and research mentor** to Leland Wood, undergraduate researcher
- 2019-present **Peer mentor** in anonymous group for early career women and trans people in geosciences
- 2019-2020 **Research mentor** to Alec Myers, post baccalaureate research assistant
- 2018-2019 **Research mentor** to Aaron Cheah, undergraduate researcher
- 2016-2018 **Research mentor** to Natalie Kellogg, undergraduate researcher, post baccalaureate research assistant
- 2015-present **Thesis and research mentor** to Regina Lionheart, undergraduate researcher, post baccalaureate research assistant, research consultant
- 2015-2017 **Research mentor** to Alexandra Weid, undergraduate researcher
- 2013-2014 **Field and research mentor** to Willow Coyote-Maestes, undergraduate researcher
- 2012-2014 **Field and research mentor** to Davey French, undergraduate researcher, post baccalaureate research assistant

OCEANOGRAPHIC SHIPBOARD EXPERIENCE

- 2019 **Chief Science Training Cruise.** Honolulu to Honolulu on *R/V Kilo Moana*, 8 days
- 2019 **Gradients 3.0 Cruise.** Honolulu to Honolulu on *R/V Kilo Moana*, 25 days
- 2017 **Gradients 2.0 Cruise.** Honolulu to Honolulu on *R/V Langseth*, 19 days
- 2015 **SCOPE Transect Cruise.** Portland to Honolulu on *R/V Kilo Moana*, 10 days
- 2013 **Dimensions of Biodiversity Cruise.** Seattle to Honolulu on *R/V Kilo Moana*, 30 days
- 2013 Hood Canal on *R/V Barnes*, 7 days
- 2013 Strait of Juan de Fuca, *R/V Thompson*, 2 days
- 2012 Hood Canal on *R/V Barnes*, 7 days
- 2012 Hood Canal on *R/V Barnes*, 7 days
- 2012 **C-MORE Summer Course Cruise.** Station ALOHA on *R/V Kilo Moana*, 10 days
- 2012 **GEOMICS Cruise.** Seattle to Seattle on *R/V Thompson*, 7 days
- 2012 Hood Canal on *R/V Barnes*, 7 days
- 2011 Hood Canal on *R/V Barnes*, 5 days
- 2011 Hood Canal on *R/V Barnes*, 5 days
- 2010 **BIG RAPA.** Arica, Chile to Easter Island, Chile on *R/V Melville*, 28 days

NONTRADITIONAL EDUCATION AND TRAINING

- 2020 Earth Educators' Rendezvous, *National Association of Geosciences Teachers*
- 2019 Early Career Chief Scientist Training Program, *UNOLS*

- 2018 An Introduction to Evidence-Based Undergraduate STEM Teaching
Ten-week course through *EdX*
- 2015 Graduate Student Certificate on Climate Change
University of Washington's Program on Climate Change
Earned certificate in 2015, active member 2011-2018
- 2012-2016 Program on Climate Change Summer Institutes (4)
Four-day workshops on varied topics of climate change
University of Washington's Program on Climate Change
- 2012 Center for Microbial Oceanography Research and Education: From
Genomes to Biomes Summer Course
Six-week immersive program at the *University of Hawai'i*

UNIVERSITY AND ACADEMIC SERVICE

- ad hoc* Reviewer for *Limnology and Oceanography* (1), *Limnology and Oceanography Methods* (2), *Geochimica et Cosmochimica Acta* (1), *Analytical Chemistry* (2), *Aquatic Microbial Ecology* (2), *Applied and Environmental Microbiology* (2), *Environmental Microbiology* (1), *ISME Journal* (1), *PNAS* (1), NSF Chemical Oceanography proposals (2)
- 2020-present Committee Member. University of Washington's School of Oceanography
Committee on Diversity, Equity, and Inclusion
- 2020-present Postdoc representative at faculty meetings
- 2019 Co-chair of session at ASLO meeting "New views on the biological
transformation of metals in the marine environment"
- 2013-2017 Peer reviewer for NSF Graduate Research Fellowship Program
applications
- 2016 Co-chair of the John Hedges Visiting Scholar committee
- 2016 Search committee member for Chemical Oceanography faculty hire
- 2012 Co-chair of the University of Washington's School of Oceanography All
Student Educational Retreat

PROFESSIONAL MEMBERSHIPS

- 2011-present American Society of Limnology and Oceanography
- 2018-present Society for Women in Marine Science
- 2018-present Metabolomics Society
- 2019-present Earth Science Women's Network
- 2019-present Phycological Society of America
- 2020-present National Association of Geoscience Teachers