

**KATHERINE R HEAL (SHE/HER)**

School of Oceanography  
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**EDUCATION**

- 2018      PhD in Chemical Oceanography  
            University of Washington  
            Advisor: Dr. Anitra Ingalls  
            “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
- 2011      BA in Environmental Chemistry  
            The Colorado College  
            Advisor: Dr. Sally Meyer

**PRIMARY RESEARCH INTERESTS**

Microbial control on biogeochemical cycling  
Ecophysiology of marine microbes  
Development and application of mass spectrometry techniques within microbial ecology

**RESEARCH EXPERIENCE**

- 2018-present    Simons Foundation Postdoctoral Fellow in Marine Ecology  
                    University of Washington  
                    Advisors: Dr. Randelle Bundy and Dr. Anitra Ingalls
- 2011-2018      Graduate Research Assistant  
                    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 Internship  
                    Oak Ridge National Laboratory  
                    Advisor: Dr. Melanie Mayes

## PEER REVIEWED PUBLICATIONS (10 total, 4 as first or co-first author)

- 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 NO<sub>2</sub>-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-Habbena, 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-Habbena, 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 B<sub>12</sub> 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 B<sub>12</sub> 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.

#### MANUSCRIPTS SUBMITTED AND IN PREPARATION (drafts available on request)

- In review **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. Submitted to *Protist*.
- In review 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. The sulfonate cycle: a new trophic link between ocean plankton. Submitted to *Nature Microbiology*.
- In review 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. Submitted to *ISME Journal*.
- In prep Dawson, H.M., Boysen, A.K., **Heal, K.R.**, Carlson, L.T., Ingalls, A.E., Young, J.N., Characterization of compatible solute use in a cultured sea-ice alga, *Nitzschia lecontei*, and in the environmental algal community of Utqiagvik, AK using a metabolomics approach. In preparation for *New Phytologist*.

#### FELLOWSHIPS AND GRANTS

- 2018 Postdoctoral Fellowship in Maine 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 Grad 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 (\$2,000)  
Department of Energy Office of Science
- 2010 Venture grant recipient (\$1,000)  
The Colorado College
- 2010 Washington State University REU (declined)  
National Science Foundation
- 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

- 2019 Selected Participant  
Early Career Chief Scientist Training Program
- 2018 Selected Participant  
Dissertations Symposium in Chemical Oceanography XXVI
- 2017 College of the Environment Graduate Dean's Medalist  
University of Washington
- 2011 Graduated cum laude with departmental distinction  
The Colorado College
- 2011 Graduate Research Fellowship Honorable Mention  
National Science Foundation

#### INVITED PRESENTATIONS

- 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. Oral presentation at Princeton University. Princeton, New Jersey.
- 2018 **Heal, K.R.** Power and promise of direct measurements of metabolites in marine systems. Invited 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 B<sub>12</sub> in the ocean as revealed through liquid-chromatography mass spectrometry. Oral presentation at Gordon Research Seminar in Chemical Oceanography, New London, NH.

#### SELECTED PRESENTATIONS (\* = undergraduate mentee)

- 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. 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 B<sub>12</sub> 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 B<sub>7</sub> and several forms of B<sub>12</sub> 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.

## TEACHING EXPERIENCE

- 2019 Instructor  
Chemistry of Marine Organic Carbon (OCN295)  
University of Washington
- 2015 Teaching Assistant (course development and implementation)  
Chemistry of Marine Organic Carbon (OCN295)  
University of Washington

- 2013 Teaching Assistant  
Chemical Oceanography (OCN400)  
University of Washington
- 2013-2014 Guest teacher  
Introduction to the Biological Pump  
Inglesmoor (Bothell, WA) and Sehome (Bellingham, WA) High Schools
- 2008-2011 Teaching Assistant – 5 courses total  
Introductory Chemistry I and II, Organic Chemistry I, Atmospheric  
Physics and Chemistry, Human Impacts on Biogeochemical Cycles  
The Colorado College

#### MENTORSHIP EXPERIENCE

- 2018- Aaron Cheah  
Biochemistry undergraduate at University of Washington
- 2016-2018 Natalie Kellogg  
Currently graduate student at University of Washington
- 2015-2017 Regina Lionheart  
Currently graduate student at University of Haifa
- 2015-2017 Alexandra Weid  
Currently teaching English in Ecuador
- 2013-2014 Willow Coyote-Maestes  
Current graduate student at the University of Minnesota
- 2012-2014 Davey French  
Current graduate student at the University of Washington

#### NONTRADITIONAL EDUCATION AND TRAINING

- 2018 An Introduction to Evidence-Based Undergraduate STEM Teaching  
Ten-week online 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
- 2012 Center for Microbial Oceanography Research and Education: From  
Genomes to Biomes Summer Course  
Six-week immersive program at the University of Hawaii

#### OCEANOGRAPHIC SHIPBOARD EXPERIENCE

- upcoming Honolulu to Honolulu on *R/V Kilo Moana*, 10 days
- 2019 Honolulu to Honolulu on *R/V Kilo Moana*, 25 days
- 2017 Honolulu to Honolulu on *R/V Langseth*, 19 days

2015	Portland to Honolulu on <i>R/V Kilo Moana</i> , 10 days
2013	Seattle to Honolulu on <i>R/V Kilo Moana</i> , 30 days
2013	Hood Canal on <i>R/V Barnes</i> , 7 days
2013	Strait of Juan de Fuca, <i>R/V Thompson</i> , 2 days
2012	Hood Canal on <i>R/V Barnes</i> , 7 days
2012	Hood Canal on <i>R/V Barnes</i> , 7 days
2012	Station ALOHA on <i>R/V Kilo Moana</i> , 10 days
2012	Seattle to Seattle on <i>R/V Thompson</i> , 7 days
2012	Hood Canal on <i>R/V Barnes</i> , 7 days
2011	Hood Canal on <i>R/V Barnes</i> , 5 days
2011	Hood Canal on <i>R/V Barnes</i> , 5 days
2010	Arica, Chile to Easter Island on <i>R/V Melville</i> , 28 days

#### UNIVERSITY AND ACADEMIC SERVICE

ongoing	Reviewer for Limnology and Oceanography (1), Limnology and Oceanography Methods (2), Geochimica et Cosmochimica Acta (1), Analytical Chemistry (1), Aquatic Microbial Ecology (1), NSF Chemical Oceanography proposals (1)
2019	Mentor at ASLO meeting for two undergraduates
2013-2017	Peer reviewer for NSF Graduate Research Fellowship Program applications
2016	Co-chair of the John Hedges Visiting Scholar committee
2016	Graduate student representative on faculty hiring committee
2012	Co-chair of the University of Washington's School of Oceanography All Student Educational Retreat