

KATHERINE R HEAL

School of Oceanography
University of Washington
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EDUCATION

- 2014-2018 PhD in Chemical Oceanography
 University of Washington
 Advisor: Dr. Anitra Ingalls
 The power and promise of direct measurements of metabolites in marine systems
- 2011- 2014 MS in Chemical Oceanography
 University of Washington
 Advisors: Dr. Anitra Ingalls and Dr. Allan Devol
- 2008-2011 BA in Environmental Chemistry
 The Colorado College
 Advisor: Dr. Sally Meyer
- 2006-2007 Attended the *University of Minnesota* – Twin Cities Campus

PRIMARY RESEARCH INTERESTS

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

PROFESSIONAL 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

Woods Hole Oceanographic Institution
Advisor: Dr. Daniel Repeta

- 2009-2010 Science Undergraduate Laboratory Internship
 Oak Ridge National Laboratory
 Advisor: Dr. Melanie Mayes
- 2009 Summer Intern
 Center for Multiscale Modeling of Atmospheric Processes
 Colorado State University

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

- 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.**
- 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.**
- 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.
- 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 oxycinae* 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.
- 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.

- 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.
- 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.
- 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.
- 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.
- 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)
- 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. In preparation for *Protist*.
- 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*.
- 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. In preparation for *Nature Microbiology*.
- 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*.

AWARDS, SCHOLARSHIPS, FELLOWSHIPS

2018	Postdoctoral Fellowship in Maine Microbial Ecology (\$261,000) <i>Simons Foundation</i>
2018	Selected Participant <i>Dissertations Symposium in Chemical Oceanography XXV</i>
2017	College of the Environment Graduate Dean's Medalist <i>University of Washington</i>
2016	Travel award to attend Ocean Science Meeting <i>College of the Environment, University of Washington</i>
2015	Graduate Student Certificate on Climate Change <i>University of Washington</i>
2012	Program Climate Change Grad Fellowship (1 yr tuition and stipend) <i>University of Washington</i>
2012	Graduate Research Fellowship (3 yr tuition and stipend) <i>National Science Foundation</i>
2012	Collaborative research travel grant (\$5000) <i>Burroughs Wellcome Fund</i>
2011	Top Scholar – Egtvedt Graduate Fellowship (1 yr tuition and stipend) <i>University of Washington</i>
2011	Graduated <i>cum laude</i> with departmental distinction <i>The Colorado College</i>
2011	Graduate Research Fellowship Honorable Mention <i>National Science Foundation</i>
2011	Travel award to attend American Society of Limnology and Oceanography annual meeting <i>National Science Foundation Research Experience for Undergraduates</i>
2010	Guest Student Honorarium (\$1000) <i>Woods Hole Oceanographic Institution</i>
2010	Science and Energy Research Challenge (\$2000) <i>Department of Energy Office of Science</i>
2010	Venture grant recipient (\$1000) <i>The Colorado College</i>
2010	Washington State University REU (declined) – <i>National Science Foundation</i>
2010	Marine Physical Lab Summer Fellowship (declined) <i>Scripps Oceanographic Institution</i>
2006-2008	Iron Range Scholarship (\$4000 per yr) <i>The University of Minnesota</i>

PROFESSIONAL PRESENTATIONS (* = student mentee)

(upcoming) **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. Invited oral presentation at Princeton University. Princeton, New Jersey. November 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. February 2018.
- 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 Research Seminar in Chemical Oceanography (invited), poster presentation at Gordon Research Conference. New London, NH. July 2017.
- Lu, X., **Heal, K.R.**, Ingalls, A.E., Doxey, A.C., Neufeld, J.C. Microbial Production of Vitamin B₁₂ in Soil. Canadian Society of Microbiologists Annual Meeting. Poster presentation. Waterloo, ON. June 2017.
- Heal, K.R.** Sources and ramifications of two pools of vitamin B₁₂ in the ocean. Oral presentation at the Chemical Oceanography lunch seminar, *University of Washington*. March 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. February 2017.
- Qin, W., Amin, S.A., Lundeen, R.A., **Heal, K.R.**, Martens-Habbena W., Urakawa, H., Costa, K.C., Turkarslan, S., Hendrickson, E., Beck, D., Tequia, S., Taub, F., Holmes, A., Lowe, T., Moffett, J.W., Devol, A.H., Baliga, N., Arp, D., Sayavedra-Soto, L.A., Hackett, M., Armbrust, E.V., Ingalls, A.E., and Devol, A.H. The transcriptome and proteome of the ammonia-oxidizing archaeon *Nitrosopumilus maritimus* reflect marine processes. International Society of Microbial Ecology, Montreal, QC. August 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. February 2016.
- 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. July 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 Molecular Life of Diatoms Conference in Seattle, WA. July 2015.

- 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 Graduate Climate Conference in Pack Forest, WA. October 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. February 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. February 2014.
- Heal, K.R.** Embracing social media to teach introductory oceanography. Poster presentation at American Society of Limnology and Oceanography in New Orleans, LA. February 2013.
- Heal, K.R.**, and the 2012 CMORE summer course. Photosynthetic parameters over hourly and daily timescales shed light on population stability at station ALOHA. Poster presentation at American Society of Limnology and Oceanography in New Orleans, LA. February 2013.
- Heal, K.R.**, and Repeta, D. Concentration of dissolved organic phosphorus (DOP) in seawater using Mg(II)-Mn(III) layered double hydroxide. Poster presentation at American Society of Limnology and Oceanography in San Juan, PR. February 2011.
- Jagadamma, S., **Heal, K.R.**, Mayes, M., Phillips, J., Tschaplinski, T., Amonette, J. Sorption selectivity of dissolved organic compounds to different soils. Poster presentation at Fall American Geophysical Union meeting in San Francisco, CA. December 2010.
- Jagadamma, S., **Heal, K.R.**, Mayes, M., Phillips, J., Tschaplinski, T., Amonette, J. Compound-specific sorption of dissolved organic carbon on soil minerals. Poster presentation at Soil Science Society of America in Conference in Long Beach, CA. October 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. June 2010.

TEACHING EXPERIENCE

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| 2015 | Teaching Assistant (course development and initial implementation)
Chemistry of Marine Organic Carbon
<i>University of Washington</i> |
| 2013 | Teaching Assistant
Chemical Oceanography
<i>University of Washington</i> |
| 2013-2014 | Guest teacher
Introduction to the Biological Pump
<i>Inglemoor (Bothell, WA) and Sehome (Bellingham, WA) High Schools</i> |

- 2008-2011 Learning Assistant – 5 courses total
Introductory Chemistry I and II, Organic Chemistry I, Atmospheric
Physics and Chemistry, Human Impacts on Biogeochemical Cycles
The Colorado College
- 2008-2011 Drop-in tutor at the Quantitative Reasoning Center
The Colorado College
- 2007-2008 Tutor
A.P. Chemistry, Biology, Calculus, Physics, Spanish, and SAT prep
College Nannies and Tutors
- 2006-2008 Volunteer Math Tutor
Preparation for the General Educational Development test
English Learning Center

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-present
- 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

2010 Oak Ridge Science Semester
Semester program affiliated with Oak Ridge National Lab and Denison
University in Oak Ridge, TN

SHIPBOARD EXPERIENCE

2017 Honolulu to Honolulu on *R/V Langseth*, 19 days
2015 Portland to Honolulu on *R/V Kilo Moana*, 10 days
2013 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 Station ALOHA on *R/V Kilo Moana*, 10 days
2012 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 Arica, Chile to Easter Island on *R/V Melville*, 28 days

UNIVERSITY AND ACADEMIC SERVICE

2014- Reviewer for *Limnology and Oceanography*, *L&O methods*, *Geochimica et Cosmochimica Acta*
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 the Trace Elements hiring committee
2012 Co-chair of the University of Washington's School of Oceanography All Student Educational Retreat