

## CURRICULUM VITAE

### **BENJAMIN S. TWINING**

Vice President for Research and Education  
Senior Research Scientist  
Bigelow Laboratory for Ocean Sciences  
60 Bigelow Drive  
PO Box 380  
East Boothbay, ME 04544  
Tel: 207-315-2567 ext 309  
Email: [btwining@bigelow.org](mailto:btwining@bigelow.org)  
Web: [http://www.bigelow.org/research/srs/benjamin\\_twining/](http://www.bigelow.org/research/srs/benjamin_twining/)  
Twitter: @DrSingleCell

### **Education**

- Ph.D. Stony Brook University, Coastal Oceanography (2003)  
Dissertation title: “The accumulation and trophic transfer of trace metals by protozoa”  
Advisor: Nicholas S. Fisher
- A.B. Harvard University, Environmental Science and Public Policy, *Magna cum laude* (1997)

### **Professional Experience**

Interim President and CEO, Bigelow Laboratory for Ocean Sciences (2017-2018)  
Vice President for Research and Education, Bigelow Laboratory for Ocean Sciences (2016-present)  
Director of Research and Education, Bigelow Laboratory for Ocean Sciences (2013-2016)  
Co-Interim Director of Finance and Administration, Bigelow Laboratory for Ocean Sciences (2013)  
Research Scientist, Colby College (2009-present)  
Senior Research Scientist, Bigelow Laboratory for Ocean Sciences (2008-present)  
Assistant Professor, Department of Chemistry and Biochemistry, University of South Carolina (2005-2008)  
Associate Faculty, Marine Science Program, University of South Carolina (2005-2008)  
Postdoctoral Fellow, Aquatic Chemistry Laboratory, Yale University (2003-2005)  
Research Assistant, Radioecology Laboratory, Stony Brook University (1999-2003)  
Research Technician, Aquatic Botany Laboratory, North Carolina State University (1997-1998)

### **Honors and Awards**

Gaylord Donnelley Environmental Postdoctoral Fellowship (2003)  
Woods Hole Oceanographic Institution Postdoctoral Scholarship (2003, declined)  
AGU Outstanding Student Paper Award, San Francisco Fall Meeting (2002)  
ASLO Student Poster Award, Albuquerque Aquatic Sciences Meeting (2001)  
NSF Graduate Fellowship Honorable Mention (1999)  
Pieper Merit Award for outstanding entering graduate students, Stony Brook University (1998)  
Okubo Award for outstanding students in oceanography, Stony Brook University (1998)

## **Professional Memberships and Service**

Association for the Sciences of Limnology and Oceanography, American Geophysical Union,  
The Oceanography Society

Finance Committee, Association for the Sciences of Limnology and Oceanography (2014-2016)

Scientific Steering Committee for Ocean Carbon Biogeochemistry Program (2017-2020)

Manuscript reviewer for *Aquatic Biology*, *Biogeosciences*, *Biology Letters*, *Deep-Sea Research*,  
*Ecology Letters*, *Environmental Chemistry*, *Environmental Science and Technology*,  
*Environmental Toxicology and Chemistry*, *Estuaries and Coasts*, *Estuarine, Coastal and  
Shelf Sciences*, *Frontiers in Marine Science*, *Geochimica et Cosmochimica Acta*,  
*Geobiology*, *Geology*, *Global Biogeochemical Cycles*, *Journal of Geophysical Research*,  
*Journal of Phycology*, *Journal of Plankton Research*, *Limnology and Oceanography*,  
*Limnology and Oceanography Letters*, *Limnology and Oceanography: Methods*, *Marine  
Chemistry*, *Marine Ecology Progress Series*, *Nature Climate Change*, *Nature Geosciences*,  
*Northeastern Naturalist*, *Oceanography*, *Philosophical Transactions A*, *PLoS One*,  
*Proceedings of the National Academy of Science*

Proposal reviewer for U.S. National Science Foundation, American Chemical Society, French  
National Research Agency (ANR), Research Grant Council of Hong Kong, Advanced Light  
Source, Louisiana Board of Regents, National Synchrotron Light Source-II, Canadian Light  
Source, South African National Research Foundation, Israel Science Foundation, Schmidt  
Ocean Institute

Co-Convener, Ocean Carbon and Biogeochemistry scoping workshop (2014): “Improving  
predictive biogeochemical models through single cell-based analyses of marine plankton  
physiological plasticity, genetic diversity and evolutionary processes”. East Boothbay,  
Maine.

Guest Associate Editor of special issue on “The microbial ferrous wheel: iron cycling in  
terrestrial, freshwater and marine environments” in *Frontiers in Microbiological Chemistry*  
Session co-chair, Ocean Sciences Meeting (2016): The Role of Particles in the Cycling of Trace  
Elements and Their Isotopes in the Ocean. New Orleans.

Session co-chair, Ocean Sciences Meeting (2014): Linking Molecular ‘Omics’ Measurements to  
Develop Conceptual and Computational Models of Ocean Microbial Ecology, Diversity and  
Biogeochemistry. Honolulu.

Session co-chair, Goldschmidt Meeting (2012): Investigating Biogeochemical Cycling using  
Micro-scale Techniques. Montreal.

Planning Committee member, 3<sup>rd</sup> GEOTRACES Data-Model Synergy Workshop, Barcelona  
(2011)

Session co-chair, Ocean Sciences Meeting (2008): Trace Metal Biogeochemistry – Interactions  
Between Atmosphere and Ocean. Orlando.

Session co-chair, Aquatic Sciences Meeting (2007): Dynamics of trace metal stoichiometry in  
plankton: causes, effects, and implications. Santa Fe.

Judge, Regional Ocean Sciences Bowl, Columbia, SC (2007)

Session co-chair, Ocean Sciences Meeting (2006): Using Trace Elements and Isotopes to Study  
Open-Ocean Biogeochemistry. Honolulu.

Session co-chair, Ocean Sciences Meeting (2006): Equatorial Physics, Biogeochemistry, and  
Air-Sea Interactions. Honolulu.

Session co-chair, American Geophysical Union Fall Meeting (2003): Microbe and Mineral  
Interactions and the Biogeochemistry of Reduced Sulfur. San Francisco.

Science fair judge, Long Island Science and Engineering Fair (2000)

### **Research interests**

marine biogeochemistry, metal-plankton interactions, single-cell analysis, trace metal speciation and bioavailability, x-ray microscopy, ecological stoichiometry, global carbon cycling and climate change

### **Peer-reviewed publications (\*denotes Twining student or post-doc as first author)**

- 70) Cohen, N., E. Mann, B. Stemple, C. Moreno, S. Rauschenberg, J. Jacquot, W. Sunda, B.S. Twining, and A. Marchetti. 2018. Iron storage capabilities and associated ferritin gene expression among marine diatoms. *Limnology and Oceanography*. In press. doi: 10.1002/lno.10800.
- 69) Cohen, N.R., K.A. Ellis, R.H. Lampe, H. McNair, B.S. Twining, M.T. Maldonado, M.A. Brzezinski, F.I. Kuzminov, K. Thamatrakoln, C.P. Till, K.W. Bruland, W.G. Sunda, S. Bargu, and A. Marchetti. 2017. Diatom transcriptional and physiological responses to changes in iron bioavailability across ocean provinces. *Frontiers in Marine Science*. In press.
- 68) Smith, H.E.K., A.J. Poulton, R. Garley, J. Hopkins, L.C. Lubelczyk, D.T. Drapeau, S. Rauschenberg, B.S. Twining, N.R. Bates, and W.M. Balch. 2017. The influence of environmental variability on the biogeography of coccolithophores and diatoms in the Great Calcite Belt. *Biogeosciences*. 14: 4905-4925.
- 67) \*Ohnemus, D.O., P.J. Lam, and B.S. Twining. 2017. Optical observation of particles and responses to particle composition in the GEOTRACES GP16 section. *Marine Chemistry*. In press. doi: 10.1016/j.marchem.2017.09.004.
- 66) Saito, M.A., A.E. Noble, N. Hawco, B.S. Twining, D.C. Ohnemus, S.G. John, P. Lam, T.M. Conway, R. Johnson, D. Moran, and M. McIlvin. 2017. The acceleration of dissolved cobalt's ecological stoichiometry due to biological uptake, remineralization, and scavenging in the Atlantic Ocean. *Biogeosciences*. 14: 4637-4662. doi: 10.5194/bg-14-4637-2017.
- 65) Brzezinski, M.A., J.W. Krause, S.B. Baines, J.L. Collier, D.C. Ohnemus, and B.S. Twining. 2017. Patterns and regulation of silicon accumulation in *Synechococcus* spp. *Journal of Phycology*. 53: 746-761. doi: 10/1111/jpy.12545.
- 64) Glass, J.B., S. Chen, K.S. Dawson, D.R. Horton, S. Vogt, E.D. Ingall, B.S. Twining, and V.J. Orphan. 2017. Trace metal imaging of sulfate-reducing bacteria and methanogenic archaea at single-cell resolution by synchrotron X-ray fluorescence imaging. *Geomicrobiology Journal*. In press. doi: 10.1080/01490451.2017.1321068.
- 63) Krause, J.W., M.A. Brzezinski, S.B. Baines, J.L. Collier, B.S. Twining, and D.C. Ohnemus. 2017. Picoplankton contributions to biogenic silica stocks and production rates in the Sargasso Sea. *Global Biogeochemical Cycles*. 31: 762-774. doi: 10.1002/2017GB005619.
- 62) Marchetti, A., C.M. Moreno, N.R. Cohen, I. Oleinikov, K. Delong, B.S. Twining, E.V. Armbrust, and R.H. Lampe. 2017. Development of a molecular-based index for assessing iron status in bloom-forming pennate diatoms. *Journal of Phycology*. 53: 820-832. doi: 10.1111/jpy.12539.
- 61) Boyd, P.W., M. Ellwood, A. Tagliabue, and B.S. Twining. 2017. Biotic and abiotic retention, recycling and remineralization of metals in the ocean. *Nature Geoscience*. 10: 167-173. doi: 10.1038/NGEO2876.

- 60) \*Ohnemus, D.C., S. Rauschenberg, J.W. Krause, M.A. Brzezinski, J.L. Collier, S. Geraci-Yee, S.B. Baines, and B.S. Twining. 2016. Silicon content of individual cells of *Synechococcus* from the North Atlantic Ocean. *Marine Chemistry*. 187: 16-24.
- 59) Hawco, N.J., D.C. Ohnemus, J.A. Resing, B.S. Twining, and M.A. Saito. 2016. A dissolved cobalt plume in the oxygen minimum zone of the eastern tropical South Pacific. *Biogeosciences*. 13: 5697-5717.
- 58) Balch, W.M., N.R. Bates, P.J. Lam, B.S. Twining, S.Z. Rosengard, B.C. Bowler, D.T. Drapeau, R. Garley, L.C. Lubelczyk, C. Mitchell, and S. Rauschenberg. 2016. Factors regulating the Great Calcite Belt in the Southern Ocean and its biogeochemical significance. *Global Biogeochemical Cycles*. 30: 1124-1144. doi: 10.1002/2016GB005414.
- 57) \*Ohnemus, D.C., S. Rauschenberg, G.A. Cutter, J.N. Fitzsimmons, R.M. Sherrell, and B.S. Twining. 2016. Elevated trace metal content of prokaryotic communities associated with marine oxygen deficient zones. *Limnology & Oceanography*. 62: 3-25.
- 56) Baines, S.B., X. Chen, S. Vogt, N.S. Fisher, B.S. Twining, and M.R. Landry. 2016. Microplankton trace element contents: implications for mineral limitation of mesozooplankton in an HNLC area. *Journal of Plankton Research*. 38: 256-270. doi: 10.1093/plankt/fbv109.
- 55) Baines, S.B., X. Chen, B.S. Twining, N.S. Fisher, and M.R. Landry. 2016. Factors affecting Fe and Zn contents of mesozooplankton from the Costa Rica Dome. *Journal of Plankton Research*. 38: 331-347. doi: 10.1093/plankt/fbv098.
- 54) Twining, B.S., S. Rauschenberg, P.L. Morton, and S. Vogt. 2015. Metal contents of phytoplankton and labile particulate material in the North Atlantic Ocean. *Progress in Oceanography*. 137: 261-283.
- 53) Boyd, P.W., R. Strzepek, M. Ellwood, D.A. Hutchins, S. Nodder, B.S. Twining, and S.W. Wilhelm. 2015. Why are biotic iron pools uniform across high- and low-iron pelagic ecosystems? *Global Biogeochemical Cycles*. 29: 1028-1043.
- 52) The GEOTRACES Group (135 co-authors). The GEOTRACES Intermediate Data Product 2014. 2015. *Marine Chemistry*. doi: 10.1016/j.marchem.2015.04.005.
- 51) Pižeta, I., S.G. Sander, R.J.M. Hudson, D. Omanović, O. Baars, K.A. Barbeau, K.N. Buck, R.M. Bundy, G. Carrasco, P.L. Croot, C. Garnier, L.J.A. Gerringa, M. Gledhill, K. Hirose, Y. Kondo, L.M. Laglera, J. Nuester, M.J.A. Rijkenberg, S. Takeda, B.S. Twining, M. Wells. Interpretation of complexometric titration data: An intercomparison of methods for estimating models of trace metal complexation by natural organic ligands. *Marine Chemistry*. 173: 3-24.
- 50) Lam, P.J., B.S. Twining, C. Jeandel, A. Roychoudhury, J. A. Resing, P.H. Santschi, R. F. Anderson. 2015. Methods for analyzing the concentration and speciation of major and trace elements in marine particles. *Progress in Oceanography*. 133: 32-42.
- 49) Twining, B.S., S. Rauschenberg, P.L. Morton, D.C. Ohnemus, and P.J. Lam. 2015. Comparison of particulate trace element concentrations in the North Atlantic Ocean as determined with discrete bottle sampling and in situ pumping. *Deep-Sea Research II*. 116: 273-282.
- 48) Rauschenberg, S., and B.S. Twining. 2015. Evaluation of approaches to estimate biogenic particulate trace metals in the ocean. *Marine Chemistry*. 171: 67-77.
- 47) \*Nuester, J., M. Newville, and B.S. Twining. 2014. Distributions of iron, phosphorus and sulfur along trichomes of the cyanobacteria *Trichodesmium*. *Metallomics*. 6: 1141-1149.

- 46) \*Nuester, J., S. Shema, A. Vermont, D.M. Fields, and B.S. Twining. 2014. The regeneration of highly bioavailable iron by meso- and microzooplankton. *Limnology and Oceanography*. 59(4): 1399-1409.
- 45) \*Ohnemus, D.C., M.E. Auro, R.M. Sherrell, M. Lagerstrom, P.L. Morton, B.S. Twining, S. Rauschenberg, and P.J. Lam. 2014. Laboratory intercomparison of marine particulate digestions including Piranha: a novel chemical method for dissolution of polyethersulfone filters. *Limnology and Oceanography: Methods*. 12: 530-547.
- 44) Twining, B.S., S.D. Nodder, A.L. King, D.A. Hutchins, G.R. LeCleur, J.M. DeBruyn, E.W. Maas, S. Vogt, S.W. Wilhelm, and P.W. Boyd. 2014. Differential remineralization of major and trace elements in sinking diatoms. *Limnology & Oceanography*. 59: 689-704.
- 43) \*Fredrick, N.D., J.A. Berges, B.S. Twining, D. Nunez-Milland, and F.L. Hellweger. 2013. Use of agent-based modeling to explore the mechanisms of intracellular phosphorus heterogeneity in cultured phytoplankton. *Applied and Environmental Microbiology*. 79: 4359-4368.
- 42) Ingall, E.D., J.M. Diaz, A.F. Longo, M. Oakes, L. Finney, S. Vogt, B. Lai, P.L. Yager, B.S. Twining, and J.A. Brandes. 2013. Role of biogenic silica in the removal of iron from Antarctic Seas. *Nature Communications*. 4: 1981, doi: 10.1038/ncomms2981.
- 41) Wilhelm, S.W., A.L. King, B.S. Twining, G.R. LeCleur, J.M. DeBruyn, R.F. Strzepek, C.L. Breene, S. Pickmere, M.J. Ellwood, P.W. Boyd, and D.A. Hutchins. 2013. Elemental quotas and physiology of a southwestern Pacific Ocean plankton community as a function of iron availability. *Aquatic Microbial Ecology*. 68: 185-194.
- 40) Twining, B.S., and S.B. Baines. 2013. The trace metal composition of marine phytoplankton. *Annual Review of Marine Science*. 5: 191-215.
- 39) Baines, S.B., B.S. Twining (co first author), M.A. Brzezinski, J.W. Krause, S. Vogt, D. Assael, and H. McDaniel. 2012. Significant quantities of silicon associated with marine picocyanobacteria. *Nature Geosciences*. 5: 886-891.
- 38) Twining, B.S., S.B. Baines, S. Vogt, and D.M. Nelson. 2012. Role of diatoms in nickel biogeochemistry in the Pacific Ocean. *Global Biogeochemical Cycles*. 26: doi: 10.1029/2011GB004233.
- 37) Emerson, D., E. Roden, and B.S. Twining. 2012. The microbial ferrous wheel: iron cycling in terrestrial, freshwater, and marine environments. *Frontiers in Microbiology*. doi: 10.3389/fmicb.2012.00383.
- 36) Boyd, P.W., R. Strzepek, S. Chiswell, H. Chang, J.M. DeBruyn, M. Ellwood, S. Keenan, A.L. King, E.W. Maas, S. Nodder, S.G. Sander, P. Sutton, B.S. Twining, S.W. Wilhelm, and D.A. Hutchins. 2012. Microbial control of diatom bloom dynamics in the open ocean. *Geophysical Research Letters*. 39: doi: 10.1029/2012GL053448.
- 35) Vernet, M., K.L. Smith, Jr., A.O. Cefarelli, J.J. Helly, R.S. Kaufmann, H. Lin, D.G. Long, A.E. Murray, B.H. Robison, H.A. Ruhl, T.J. Shaw, A.D. Sherman, J. Sprintall, G.R. Stephenson, Jr., K.M. Stuart, and B.S. Twining. 2012. Islands of ice: Influence of free-drifting Antarctic icebergs on pelagic marine ecosystems. *Oceanography*. 25: 16-17.
- 34) \*Nuester, J., S. Vogt, and B.S. Twining. 2012. Localization of iron within centric diatoms of the genus *Thalassiosira*. *Journal of Phycology*. 48: 626-634.
- 33) \*Nuester, J., S. Vogt, M. Newville, A. B. Kustka, and B.S. Twining. 2012. The unique biogeochemical signature of the marine diazotroph *Trichodesmium*. *Frontiers in Microbiology*. 3: 1-15 (doi: 10.3389/fmicb.2012.00150).

- 32) \*Lin, H., and B.S. Twining. 2012. Chemical speciation of iron in Antarctic waters surrounding free-drifting icebergs. *Marine Chemistry*. 128-129: 81-91.
- 31) \*King, A.L. S.A. Sanudo-Wilhelmy, P.W. Boyd, B.S. Twining, S.W. Wilhelm, C. Breene, M.J. Ellwood, and D.A. Hutchins. 2012. A comparison of biogenic iron quotas during a diatom spring bloom using multiple approaches. *Biogeosciences*. 9: 667-687.
- 30) \*Bucci, V., D. Nunez-Milland, B.S. Twining, and F.L. Hellweger. 2012. Microscale patchiness leads to large and important intraspecific internal nutrient heterogeneity in phytoplankton. *Aquatic Ecology*. 46: 101-118.
- 29) \*Lin, H., S. Rauschenberg, C.R. Hexel, T.J. Shaw, and B.S. Twining. 2011. Free-drifting icebergs as sources of iron to the Weddell Sea. *Deep-Sea Research II*. 58: 1392-1406.
- 28) Brzezinski, M., S. Baines, W.M. Balch, C. Beucher, F. Chai, R.C. Dugdale, J.W. Krause, M.R. Landry, A. Marchi, C. Measures, D.M. Nelson, A. Parker, A. Poulton, K.E. Selph, P. Strutton, A.G. Taylor, B.S. Twining. 2011. Co-limitation of diatoms by iron and silicic acid in the equatorial Pacific. *Deep-Sea Research II*. 58: 493-511.
- 27) Baines, S.B., B.S. Twining, S. Vogt, N.S. Fisher, and D.M. Nelson. 2011. Silicification of Equatorial Pacific diatoms exposed to additions of silicic acid and iron. *Deep-Sea Research II*. 58: 512-523.
- 26) Twining, B.S., S.B. Baines, J.B. Bozard, S. Vogt, E.A. Walker, and D.M. Nelson. 2011. Metal quotas of plankton in the equatorial Pacific Ocean. *Deep-Sea Research II*. 58: 325-341.
- 25) Baines, S.B., B.S. Twining, M.A. Brzezinski, D.M. Nelson, and N.S. Fisher. 2010. The causes and biogeochemical implications of regional differences in silicification of marine diatoms. *Global Biogeochemical Cycles*. doi: 10.1029/2010GB003856.
- 24) \*Krause, J.W., M.A. Brzezinski, M.R. Landry, S.B. Baines, D.M. Nelson, K.E. Selph, A.G. Taylor, and B.S. Twining. 2010. The impact of biogenic silica detritus and large diatoms on Si cycling in the euphotic zone of the eastern equatorial Pacific. *Limnology & Oceanography*. 55: 2608-2622.
- 23) De Jonge, M.D., C. Holzner, S.B. Baines, B.S. Twining, K. Ignatyev, J. Diaz, D.L. Howard, A. Miceli, I. McNulty, C.J. Jacobsen, S. Vogt. 2010. Quantitative 3-D elemental microtomography of diatom *Cyclotella meneghiniana*. *Proceedings of the National Academy of Sciences*. 107: 15676-15680.
- 22) \*Nuñez-Milland, D.R., S.B. Baines, S. Vogt, and B.S. Twining. 2010. Quantification of phosphorus in single cells using synchrotron x-ray fluorescence. *Journal of Synchrotron Radiation*. 17: 560-566.
- 21) \*Hill, L.S., T.L. Richardson, L.T.M. Profeta, T.J. Shaw, C.J. Hinz, B.S. Twining, E. Lawrenz, and M.L. Myrick. 2010. Construction, figures of merit and testing of a single-cell fluorescence excitation spectroscopy system. *Review of Scientific Instruments*. 81: doi:10.1063:1.3270251.
- 20) Twining, B.S., D. Nuñez-Milland, S. Vogt, R.S. Johnson, and P.N. Sedwick. 2010. Variations in *Synechococcus* cell quotas of phosphorus, sulfur, manganese, iron, nickel and zinc within mesoscale eddies in the Sargasso Sea. *Limnology & Oceanography*. 55: 492-506.
- 19) \*Dalbec, A.A., and B.S. Twining. 2009. Remineralization of bioavailable iron by a heterotrophic dinoflagellate. *Aquatic Microbial Ecology*. 54: 279-290.

- 18) Twining, B.S., S.B. Baines, S. Vogt, and M. D. de Jonge. 2008. Exploring ocean biogeochemistry by single-cell microprobe analysis of protist elemental composition. *Journal of Eukaryotic Microbiology*. 55: 151-162.
- 17) Hochella, M.F., Jr., S.K. Lower, P.A. Maurice, R.L. Penn, N. Sahai, D.L. Sparks, and B.S. Twining. 2008. Nanominerals, mineral nanoparticles, and earth systems. *Science*. 319: 1631-1635.
- 16) Outten, F.W., and B.S. Twining. 2008. Metal homeostasis. *Wiley Encyclopedia of Chemical Biology*. 1-10.
- 15) Smith, K.L., B.H. Robison, J.J. Helly, R.S. Kaufmann, H.A. Ruhl, T.J. Shaw, B.S. Twining, and M. Vernet. 2007. Free-drifting icebergs: Hotspots of chemical and biological enrichment in the Weddell Sea. *Science*. 317: 478-482.
- 14) Twining, B.S., S.E. Mylon, and G. Benoit. 2007. Potential role of copper availability in nitrous oxide accumulation in a temperate lake. *Limnology & Oceanography*. 52: 1354-1366.
- 13) Twining, B.S., S.B. Baines, N.S. Fisher, and M.R. Landry. 2004. Cellular iron contents of plankton during the Southern Ocean Iron Experiment (SOFeX). *Deep-Sea Research I*. 51: 1827-1850.
- 12) Twining, B.S., S.B. Baines, and N.S. Fisher. 2004. Element stoichiometries of individual plankton cells collected during the Southern Ocean Iron Experiment (SOFeX). *Limnology & Oceanography*. 49: 2115-2128.
- 11) Coale, K.H., K.S. Johnson, F.P. Chavez, K.O. Buesseler, R.T. Barber, M.A. Brzezinski, W.P. Cochlan, F.J. Millero, P.G. Falkowski, J.E. Bauer, R.H. Wanninkhof, R.M. Kudela, M.A. Altabet, B.E. Hales, T. Takahashi, M.R. Landry, R.R. Bidigare, X. Wang, Z. Chase, P.G. Strutton, G.E. Friederich, M.Y. Gorbunov, V.P. Lance, A.K. Hilting, M.R. Hiscock, M. Demerest, W.T. Hiscock, K.F. Sullivan, S.J. Tanner, R.M. Gordon, C.N. Hunter, V.A. Elrod, S.E. Fitzwater, J.L. Jones, S. Tozzi, M. Koblizek, A.E. Roberts, J. Herndon, J. Brewster, N. Ladizinsky, G. Smith, D. Cooper, D. Timothy, S.L. Brown, K.E. Selph, C.C. Sheridan, B.S. Twining, and Z.I. Johnson. 2004. Southern Ocean Iron Enrichment Experiment (SOFeX): Carbon cycling in high- and low-Si waters. *Science*. 304: 408-414.
- 10) Twiss, M.R., B.S. Twining, and N.S. Fisher. 2004. Bioconcentration of inorganic and organic thallium by freshwater phytoplankton. *Environmental Toxicology and Chemistry*. 23: 968-973.
- 9) Twining, B.S. and N.S. Fisher. 2004. Trophic transfer of trace metals from protozoa to mesozooplankton. *Limnology & Oceanography*. 49: 28-39.
- 8) Twining, B.S., S.B. Baines, N.S. Fisher, J. Maser, S. Vogt, C. Jacobsen, A. Tovar-Sanchez, S. Sañudo-Wilhelmy. 2003. Quantifying trace elements in individual aquatic protist cells with a synchrotron x-ray fluorescence microprobe. *Analytical Chemistry*. 75: 3806-3816.
- 7) Twining, B.S., M.R. Twiss, and N.S. Fisher. 2003. Oxidation of thallium by Great Lakes plankton communities. *Environmental Science and Technology*. 37: 2720-2726.
- 6) Wong, W.H., J.S. Levinton, B.S. Twining, N.S. Fisher, B.P. Kelaher, and A.K. Alt. 2003. Assimilation of carbon from a rotifer by mussels *Mytilus edulis* and *Perna viridis*: a potential marine food web link. *Marine Ecology Progress Series*. 253: 175-182.
- 5) Mylon, S.E., B.S. Twining, N.S. Fisher, and G. Benoit. 2003. Relating the speciation of Cd, Cu, and Pb in two Connecticut rivers with their uptake in algae. *Environmental Science and Technology*. 37: 1261-1267.

- 4) Wong, W.H., J.S. Levinton, B.S. Twining, and N.S. Fisher. 2003. Assimilation of micro- and mesozooplankton by zebra mussels: A demonstration of the food web link between zooplankton and benthic suspension feeders. *Limnology & Oceanography*. 48: 308-312.
- 3) Twiss, M.R., B.S. Twining, and N.S. Fisher. 2003. Partitioning of dissolved thallium by seston in Lakes Erie and Ontario. *Canadian Journal of Fisheries and Aquatic Sciences*. 60: 1369-1375.
- 2) Twining, B.S., J.J. Gilbert, and N.S. Fisher. 2000. Evidence of homing behavior in the coral reef mysid *Mysidium gracile*. *Limnology & Oceanography*. 45: 1845-1849.
- 1) Beaulieu, S.E., M.M. Mullin, V.T. Tang, S.M. Pyne, A.L. King, and B.S. Twining. 1999. Using an optical plankton counter to determine the size distributions of preserved zooplankton samples. *Journal of Plankton Research*. 21: 1939-1956.

#### *Submitted*

- Lampe, R.H., N.R. Cohen, K.A. Ellis, K.W. Bruland, M.T. Maldonado, T.D. Peterson, C.P. Till, M.A. Brzezinski, S. Bargu, K. Thamatrakoln, F.I. Kuzminov, B.S. Twining, and A.M. Marchetti. Divergent gene expression among phytoplankton taxa in response to upwelling. *Environmental Microbiology*. In review.
- \*Ohnemus, D.O., J.W. Krause, M.A. Brzezinski, J.L. Collier, S.B. Baines, and B.S. Twining. The chemical form of silicon in marine *Synechococcus*. *Marine Chemistry*. In review.
- Garcia, C.A., S.E. Baer, N.S. Garcia, S. Rauschenberg, B.S. Twining, M.W. Lomas, and A.C. Martiny. Nutrient supply controls particulate elemental concentrations and ratios in the eastern Indian Ocean. *Nature Communications*. In review.
- Baer, S.E., N.S. Garcia, C.A. Garcia, S. Rauschenberg, A.C. Martiny, B.S. Twining, M.W. Lomas. Biogeochemistry of the oligotrophic eastern Indian Ocean. *Deep-Sea Research II*. In review.

#### **Reports and conference proceedings**

- Twining, B.S., D.C. Ohnemus, and R.L. Torrie. 2016. Trace metal uptake and remineralization and their impact on upper ocean stoichiometry. *OCB Summer 2016 Newsletter*: 21-25.
- De Jonge, M.D., B. Hornberger, C. Holzner, B. Twining, D. Paterson, I. McNulty, C. Jacobsen, and S. Vogt. 2008. Quantitative scanning differential phase contrast microscopy. *Journal de Physique IV*.
- Twining, B.S., S.B. Baines, and N.S. Fisher. 2004. Metal cycling through plankton communities: a single-cell approach using synchrotron-based x-ray fluorescence. *Rapp. Comm. Int. Mer. Medit.* 37: 251.
- Twining, B.S., S.B. Baines, and N.S. Fisher. 2003. Quantification of Si, P, S, Mn, Fe, and Zn in cultured phytoplankton and Southern Ocean protists. *2002 APS User Activity Report*. 2 pp.
- Twining, B.S., S.B. Baines, N.S. Fisher, C. Jacobsen, and J. Maser. 2003. Quantification and localization of trace metals in natural plankton cells using a synchrotron x-ray fluorescence microprobe. *Journal de Physique IV*. 104: 435-438.
- Twining, B.S., S.B. Baines, N.S. Fisher, C. Jacobsen, and J. Maser. 2001. Quantification of trace elements in cultured phytoplankton cells using an x-ray fluorescence microprobe. *2001 APS User Activity Report*. 2 pp.



- Twining, B.S., S.B. Baines, and N.S. Fisher. 2001. Measurement of metal concentrations in marine nanoplankton cells using a x-ray fluorescence microprobe. *Rapp. Comm. Int. Mer. Medit.* 36: 169.
- Twining, B.S., S.B. Baines, N.S. Fisher, C. Jacobsen, and J. Maser. 2000. Quantification and localization of elements in nanoplankton cells using an x-ray fluorescence microprobe. *2000 APS User Activity Report.* 2 pp.

### **Invited presentations**

- July, 2017. Taxon-specific responses of diatoms to micronutrient gradients in the ocean revealed by single-cell element analysis. 15th International Congress of Protistology. Prague, Czech Republic.
- July, 2017. Exploring the role of plankton in climate change, one cell at a time. Bowdoin College Coastal Studies Center Summer Research Symposium. Harpswell, ME.
- March, 2017. Constraining the global phytoplankton metallome, one cell at a time. Rutgers University. New Brunswick, NJ.
- September, 2016. Oil spills and nutrients in the warming Arctic Ocean. Portland Public Library. Portland, ME.
- August, 2016. Stoichiometry of biological uptake and remineralization. Biogeochemical cycling of trace elements within the ocean: A synthesis workshop. Lamont-Doherty Earth Observatory. Palisades, NY.
- January, 2016. Connecting phytoplankton and climate change, one cell at a time. Sippican Philosophical Society. Marion, MA.
- September, 2015. Analytical (biogeo)chemistry on the high seas: the international GEOTRACES program. Colby College. Waterville, ME.
- June, 2015. Tales from an oceanographer. Waynflete School. Portland, ME.
- April, 2015. Tracking phytoplankton metallomes across environmental gradients in the ocean, one cell at a time. UC Santa Barbara, CA.
- October, 2014. Decoding the ocean's black box: exploration in global biogeochemistry through microbial oceanography. Bates College. Lewiston, ME.
- April, 2014. Tracking the metallomic responses of phytoplankton to environmental gradients in the ocean. EAWAG. Dubendorf, Switzerland.
- October, 2013. Unraveling the roles of plankton in ocean biogeochemistry, one cell at a time. University of Tennessee—Knoxville. Knoxville, TN.
- August, 2013. The microbial ocean: Epicenter of life on earth. Phippsburg Land Trust Annual Meeting. Sebasco Harbor Resort, ME.
- August, 2013. Application of synchrotron x-ray fluorescence mapping and absorption spectroscopy in marine (and environmental) science. NSLS-II Early Science Workshop. Brookhaven National Laboratory. Upton, NY
- August, 2013. Studying the ocean through SXRF analyses of its smallest residents. X-ray Fluorescence Microscopy in Biology Workshop. Northwestern University. Chicago, IL.
- May, 2013. Tracking the metallomic responses of phytoplankton to environmental gradients in the ocean. 96<sup>th</sup> Canadian Chemistry Conference. Québec, Quebec.
- February, 2013. The microbial ocean: Epicenter of life on earth. First Parish Church. Brunswick, ME.
- December, 2012. Trace metal composition of marine plankton: Linking ecosystem form to biogeochemical function. Stony Brook University. Stony Brook, NY.

December, 2012. *Silent Spring Revisited: 50 Years Later*. Cornerstones of Science. Portland, ME.

November, 2011. Role of plankton in the cycling of trace elements and isotopes. GEOTRACES Data-Model Synergy Workshop. Barcelona, Spain.

October, 2011. Exploring the Southern Ocean with Maine Scientists: Bringing Oceanography to Island Classrooms. 2011 Island Institute Teacher's Conference. Rockland, ME.

August, 2011. Trace metal composition of marine plankton: Linking ecosystem form to biogeochemical function. Chemical Oceanography Gordon Research Conference. Andover, NH.

June, 2011. FeCycle II: Quantifying the cycling of Fe and C during a spring diatom bloom. Modeling and Synthesis of Southern Ocean Natural Iron Fertilization Workshop. Woods Hole Oceanographic Institution. Woods Hole, MA.

April, 2011. Insights into oceanic metal cycling from single-cell element analysis. Massachusetts Institute of Technology. Cambridge, MA.

October, 2010. Studying ocean biogeochemistry, one cell at a time. Lafayette College. Easton, PA.

October, 2010. Antarctic Icebergs: floating estuaries in a warming world. COSEE Ocean Systems ROLE Model Webinar.

September, 2010. Global warming and Antarctic icebergs: floating estuaries in the Southern Ocean. Carleton-Willard Village. Bedford, MA.

June, 2010. Trace nutrient limitation and individual cell elemental composition. Bowdoin College. Brunswick, ME.

June, 2010. Mapping trace metals in marine plankton: clues to metal function and fate. Environmental Inorganic Chemistry Gordon Research Conference. Newport, RI.

March, 2010. Studying ocean biogeochemistry, one cell at a time. Colby College. Waterville, ME.

November, 2009. Elemental composition of plankton in the equatorial Pacific Ocean: Evidence of diatom co-limitation by iron and silicic acid. Old Dominion University. Norfolk, VA.

July, 2009. Global warming and the proliferation of icebergs: Floating estuaries in the Southern Ocean. Thornton Oaks Retirement Community. Brunswick, ME.

June, 2009. Global warming and the proliferation of icebergs: Floating estuaries in the Southern Ocean. *Café Scientifique*. Boothbay Harbor, ME.

May, 2009. Ocean science in the 21<sup>st</sup> century: Where has ocean science come since the publication of *The Sea Around Us?* Cornerstones of Science. Brunswick, ME.

May, 2009. Global climate change, the role of the oceans, and icebergs in the Weddell Sea. First Church in Wenham. Wenham, MA.

February, 2009. Examining the role of plankton in ocean biogeochemistry, one cell at a time. University of Maine. Orono, ME.

November, 2007. Examining the role of plankton in ocean biogeochemistry, one cell at a time. Georgia Institute of Technology. Atlanta, GA.

August, 2007. Examining the elemental composition of ocean plankton one cell at a time. University of Rhode Island Graduate School of Oceanography. Narragansett, RI.

August, 2007. The roles of protists in ocean iron biogeochemistry. Joint Annual Meeting of the International Society of Protistologists and the Phycological Society of America. Providence, RI.

- June, 2007. Unraveling the roles of plankton in ocean biogeochemistry. Bigelow Laboratory for Ocean Sciences. Boothbay Harbor, ME.
- March, 2007. Phytoplankton trace metal quotas across nutrient gradients in HNLC waters. Duke University Marine Lab. Beaufort, NC.
- December, 2006. Examining the elemental composition of ocean plankton one cell at a time. University of South Carolina Department of Geology. Columbia, SC.
- November, 2006. Planktonic metal stoichiometries in HNLC waters: A single-cell approach using synchrotron-based x-ray fluorescence. Texas A&M University—Galveston, TX.
- October, 2006. Dynamic metal quotas in ocean phytoplankton: Insights from single-cell x-ray analysis. University of South Carolina Plant Biology Seminar. Columbia, SC.
- October, 2006. Trace metal stoichiometries in ocean plankton: Insights from single-cell x-ray analysis. Coastal Georgia Environmental Symposium. Savannah, GA.
- June, 2006. Metal cycling through plankton communities: a single-cell approach utilizing synchrotron-based x-ray fluorescence. Bigelow Laboratory for Ocean Sciences. Boothbay Harbor, ME.
- May, 2006. Breakthroughs in nano-related environmental- and geo-science: Scaling from nano to global. Molecular- and nano-environmental geochemistry working group. National Science Foundation.
- July, 2005. Measuring element stoichiometries of ocean plankton with a hard x-ray fluorescence microprobe. Advanced Photon Source User Science lunch seminar.
- May, 2005. Measuring element stoichiometries of ocean plankton with a hard x-ray fluorescence microprobe. Advanced Photon Source Users Meeting.
- February, 2005. Stoichiometric responses of Southern Ocean plankton to iron fertilization: Expanding stoichiometry to include trace elements. American Society of Limnology and Oceanography Aquatic Sciences Meeting. Salt Lake City, UT.
- August, 2004. Metal cycling through plankton communities: a single-cell approach utilizing synchrotron-based x-ray fluorescence. University of South Carolina, Department of Chemistry and Biochemistry.
- April, 2004. Metal cycling through plankton communities: a single-cell approach. Yale Institute for Biospheric Studies seminar series.
- May, 2003. Quantification and localization of trace metals in marine and freshwater protists using a synchrotron x-ray fluorescence microprobe. National Synchrotron Light Source Users meeting.
- March, 2003. Element stoichiometries within Southern Ocean nanoplankton communities as measured with a synchrotron x-ray fluorescence microprobe. Woods Hole Oceanographic Institution, Marine Chemistry & Geochemistry.
- May, 2001. Measurement of trace element concentrations in marine and freshwater microbes using x-ray microscopy. Biological applications of x-ray microbeams workshop, Advanced Photon Source.

**Contributed presentations (\*denotes Twining student or post-doc presentation)**

- Twining, B.S. 2018. Contrasts in trace element content of marine phytoplankton from different ocean basins. Ocean Sciences Meeting. Portland, OR.
- Tagliabue, A., A. Bowie, M. Ellwood, W. Landing, A. Milne, B. Twining, and P. Boyd. 2018. Quantifying the internal cycling of iron in the ocean from basin scale sections, process studies and numerical models. Ocean Sciences Meeting. Portland, OR.

- Morton, P., B. Twining, S. Rauschenberg, and E. Collins. 2018. Influence of brine release and sea ice melt on particulate trace element biogeochemistry. Ocean Sciences Meeting, Portland, OR.
- Maniscalco, M., H. McNair, R. Lampe, N. Cohen, K. Ellis, A. Marchetti, B. Twining, C. Till, M. Brown, T. Coale, K. Bruland, M. Brzezinski, and K. Thamtracoln. 2018. Molecular drivers behind increased Si:N uptake in an iron stressed diatom assemblage. Ocean Sciences Meeting. Portland, OR.
- \*Mann, E., N. Cohen, S. Rauschenber, R. Lampe, J. Jacquot, A. Marchetti, and B. Twining. 2018. Metal quotas in diatoms from the California Current iron mosaic. Ocean Sciences Meeting. Portland, OR.
- \*Ohnemus, D., and B. Twining. 2018. Visualizing latent particulate phases and differential metal remineralization in the GEOTRACES era. Ocean Sciences Meeting. Portland, OR.
- Lampe, R., E. Mann, N. Cohen, C. Till, K. Thamtracoln, F. Kuzminov, M. Brzezinski, K. Bruland, B. Twining, and A. Marchetti. 2018. Different iron storage strategies among bloom-forming diatoms. Ocean Sciences Meeting. Portland, OR.
- Baer, S.E., B.S. Twining, M.W. Lomas, and A.C. Martiny. 2017. The role of autotrophic biomass in marine particulate organic carbon. Ocean Carbon Biogeochemistry Summer Meeting. Woods Hole, MA.
- Lampe, R.H., N.R. Cohen, K.A. Ellis, K.W. Bruland, M.T. Maldonado, M.A. Brzezinski, K. Thamtracoln, B.S. Twining, and A. Marchetti. 2017. Divergent gene expression among phytoplankton taxa in response to upwelling. Aquatic Sciences Meeting. Honolulu, HI.
- Marsay, C.M., W.M. Landing, P.L. Morton, B. Summers, S. Rauschenberg, B.S. Twining, and C.S. Buck. 2017. Dissolved and particulate trace elements in Arctic melt ponds. Aquatic Sciences Meeting. Honolulu, HI.
- Twining, B.S., S. Rauschenberg, and P.L. Morton. 2017. Trace metal contents of biogenic particles and phytoplankton in the upper Arctic Ocean and Arctic sea ice. Aquatic Sciences Meeting. Honolulu, HI.
- Cohen, N.R., R.H. Lampe, H. McNair, K.A. Ellis, F.I. Kuzminov, M.A. Brzezinski, K. Thamtracoln, M.T. Maldonado, C.P. Till, K.W. Bruland, B.S. Twining, and A. Marchetti. Coupling nutrient dynamics with metatranscriptomics to elucidate the responses of diatoms to changing iron availability across ocean provinces. Aquatic Sciences Meeting. Honolulu, HI.
- Morton, P.L., B.S. Twining, S. Rauschenberg, R. Weisend. 2017. Geochemical cycling of shelf-derived particles in the western Arctic Ocean. Aquatic Sciences Meeting. Honolulu, HI.
- Garcia, C.A., N.S. Garcia, S.E. Baer, S. Rauschenberg, B.S Twining, M.W. Lomas, and A.C. Martiny. 2017. Regional differences and diel rhythm of particulate elemental concentrations and ratios in the eastern Indian Ocean. Aquatic Sciences Meeting. Honolulu, HI.
- Greenwood, P.G., and B.S. Twining. 2017. The Changing Oceans semester-in-residence program: a research intensive program offered by Colby College and Bigelow Laboratory for Ocean Sciences. Aquatic Sciences Meeting. Honolulu, HI.
- Baer, S.E., S. Rauschenberg, A. Steinberger, A.C. Martiny, B.S. Twining, and M.L. Lomas. 2016. Phytoplankton ecology in the ultraoligotrophic Indian Ocean. Ocean Carbon Biogeochemistry Summer Meeting. Woods Hole, MA.

- Marchetti, A., M. Robert, N. Cohen, B. Twining, and P. Harrison. 2016. Altered phytoplankton dynamics associated with the North Pacific Blob provides a glimpse of future warming oceans. Ocean Sciences Meeting. New Orleans, LA.
- Brzezinski, M., J. Krause, B. Twining, S. Baines, and J. Collier. 2016. Patterns and regulation of silicon accumulation in *Synechococcus* sp. Ocean Sciences Meeting. New Orleans, LA.
- Collier, J., M. Brzezinski, S. Baines, J. Krause, D. Ohnemus, and B. Twining. 2016. Searching for potential silicon-associated genes in cyanobacteria. Ocean Sciences Meeting. New Orleans, LA.
- Baines, S., B. Twining, D. Ohnemus, J. Krause, J. Collier, and M. Brzezinski. 2016. Role of *Synechococcus* to biogenic silica cycling in the North Atlantic. Ocean Sciences Meeting. New Orleans, LA.
- Krause, J., M. Brzezinski, S. Baines, J. Collier, D. Ohnemus, and B. Twining. 2016. Picoplankton contribution to biogenic silica stocks and production rates in the Sargasso Sea. Ocean Sciences Meeting. New Orleans, LA.
- \*Ohnemus, D., J. Krause, M. Brzezinski, S. Baines, J. Collier, and B. Twining. 2016. Accumulation and speciation of Si by *Synechococcus* examined by single-cell synchrotron x-ray fluorescence and bulk x-ray spectroscopy. Ocean Sciences Meeting. New Orleans, LA.
- Caprara, S., J. Fitzsimmons, D. Ohnemus, B. Twining, D. Chappell, R. Sherrell, D. Monticelli, and K. Buck. 2016. Investigating feedbacks between natural metal-binding organic ligands and particle dissolution in central California coast seawater. Ocean Sciences Meeting. New Orleans, LA.
- Twining, B., J. Jacquot, S. Rauschenberg, J. Enright, A. Marchetti, N. Cohen, M. Brown, C. Parker, and K. Bruland. 2016. Response of phytoplankton iron contents to gradients in iron availability in the California Current System. Ocean Sciences Meeting. New Orleans, LA.
- Boiteau, R., D. Repeta, J. Fitzsimmons, C. Parker, B. Twining, and S. Baines. 2016. Revealing sources and chemical identity of iron ligands across the California Current System. Ocean Sciences Meeting. New Orleans, LA.
- Cohen, N., J. Jacquot, B. Stemple, W. Sunda, B. Twining, and A. Marchetti. 2016. Iron storage capacity and its ecological role within phylogenetically distinct marine diatoms. Ocean Sciences Meeting. New Orleans, LA.
- \*Ohnemus, D.C., S. Rauschenberg, G.A. Cutter, and B.S. Twining. 2015. Elevated trace metal content of prokaryotic plankton communities associated with anoxic marine zones. Chemical Oceanography Gordon Research Conference. Holderness School, NH.
- Morton, P.L., and B.S. Twining. 2015. Biogeochemical cycling of particulate trace elements in the Western Arctic Basin. IMBER Regional Meeting: The Role of Ice in the Sea. Seattle, WA.
- Glass, J.B., S.E. McGlynn, S. Chen, K.S. Dawson, G. Chadwick, J. Deng, S. Vogt, E. D. Ingall, B.S. Twining, and V.J. Orphan. 2015. Nano-scale imaging of cultured and uncultured anaerobic microbial consortia by synchrotron X-ray fluorescence mapping. Astrobiology Science Conference. Chicago, IL.
- Balch, W.M., N.R. Bates, P.J. Lam, and B.S. Twining. 2015. Small coccolithophores with a big impact: The Great Calcite Belt. ASLO Aquatic Sciences Meeting. Grenada, Spain.
- \*Ohnemus, D.O., S. Rauschenberg, and B.S. Twining. 2014. Trace element composition of phytoplankton along the US GEOTRACES Pacific Zonal Transect: Comparing single-

- cell SXRF quotas, chemical leaching, and bulk particle digestion. AGU Fall Meeting. San Francisco, CA.
- Twining, B.S., S. Rauschenberg, J. Vedamati, J. Moffett, and P. Sedwick. 2014. Response of phytoplankton metal quotas to oceanic gradients in dissolved and particulate metals. Goldschmidt Conference. Sacramento, CA.
- Glass, J.B., S.E. McGlynn, G. Chadwick, K.S. Dawson, S. Chen, S. Vogt, B. Lai, J. Deng, E.D. Ingall, B.S. Twining, and V.J. Orphan. 2014. Nano-scale elemental imaging of microbes and minerals from deep sea methane seeps. Goldschmidt Conference. Sacramento, CA.
- Twining, B.S., S.E.K. Rauschenberg, P.N. Sedwick, J.N. Fitzsimmons, and K.N. Buck. 2014. Iron quotas of North Atlantic phytoplankton reflect biogeochemical environment. Ocean Sciences Meeting. Honolulu, HI.
- Fields, D.M., H.I. Broman, and B.S. Twining. 2014. Copepods intestines: 10<sup>21</sup> microbioreactors of global ocean processes. Ocean Sciences Meeting. Honolulu, HI.
- Balch, W.M., N.R. Bates, B.S. Twining, P.J. Lam, and D.T. Drapeau. 2014. The Great Calcite Belt and the saga of residual nitrate. Ocean Sciences Meeting. Honolulu, HI.
- \*Chapman, A.U., J. Nuester, and B.S. Twining. 2014. Regeneration of Fe(II) by protist grazing in the ocean. Ocean Sciences Meeting. Honolulu, HI.
- Baines, S.B., M.R. Landry, S.L. Smith, B.S. Twining, and X. Chen. 2014. Trace metal limitation of zooplankton in the Costa Rican upwelling dome. Ocean Sciences Meeting. Honolulu, HI.
- \*Nuester, J., S. Rauschenberg, A. Chapman, D.M. Fields, and B.S. Twining. 2014. Zooplankton grazing produces highly bioavailable iron. Ocean Sciences Meeting. Honolulu, HI.
- Twining, B.S., and S. Rauschenberg. 2013. Gradients in biogenic metal stoichiometries across the US GEOTRACES North Atlantic Section. Chemical Oceanography Gordon Research Conference. Biddeford, ME.
- \*Nuester, J., S. Shema, D. Fields, and B.S. Twining. 2013. Regenerated Fe is tastier than inorganic Fe. Chemical Oceanography Gordon Research Conference. Biddeford, ME.
- \*Hellweger, F.L., N.D. Fredrick, J.A. Berges, and B.S. Twining. 2013. Cause and consequences of intraspecific internal nutrient heterogeneity in phytoplankton – Insights from agent-based models. FEMS 2013 – 5th Congress of European Microbiologists. Leipzig, Germany.
- Balch, W.M., B.S. Twining, D.T. Drapeau, B.C. Bowler, L.C. Lubelczyk, N.R. Bates, P.J. Lam, H.E. Smith, and A.J. Poulton. 2013. The Great Calcite Belt: a circum-global coccolithophore feature in the Southern Ocean. ASLO Aquatic Sciences Meeting. New Orleans, LA.
- Fredrick, N.D., J.A. Berges, B.S. Twining, D. Nunez-Milland, and F.L. Hellweger. 2013. Exploring mechanisms of P content heterogeneity in cultured phytoplankton using agent-based modeling. ASLO Aquatic Sciences Meeting. New Orleans, LA.
- Bates, N.R., R. Garley, W.M. Balch, B.S. Twining, and P.J. Lam. 2013. Feedbacks between air-sea CO<sub>2</sub> fluxes and coccolithophores. ASLO Aquatic Sciences Meeting. New Orleans, LA.
- \*Nielsdottir, M.C., B.L. Honisch, S. Rauschenberg, S. Vogt, and B.S. Twining. 2013. Dissolved iron requirements and elemental quotas of *Emiliania huxleyi* strains isolated from coastal and oceanic environments. ASLO Aquatic Sciences Meeting. New Orleans, LA.

- Twining, B.S., A. Ruacho, B. Honisch, and S. Rauschenberg. 2013. Trends in metal limitation of phytoplankton and coccolithophores along the “Great Calcite Belt” in the Southern Ocean. ASLO Aquatic Sciences Meeting. New Orleans, LA.
- Baines, S.B., X. Chen, B.S. Twining, and M.L. Landry. 2013. Potential for mineral limitation of zooplankton from an HNLC region (the Costa Rican upwelling dome). ASLO Aquatic Sciences Meeting. New Orleans, LA.
- Fields, D.M., B.S. Twining, and H.I. Browman. 2013. Copepod intestines: 10<sup>21</sup> microbioreactors of global ocean processes. ASLO Aquatic Sciences Meeting. New Orleans, LA.
- \*Nuester, J., and B.S. Twining. 2012. Regenerated Fe is tasty! American Geophysical Union Fall Meeting. San Francisco, CA.
- \*Pritchard, K.R., J. Nuester, and B.S. Twining. 2012. Examining the impact of grazing on iron remineralization: effect of prey type on digestive vacuole pH. American Geophysical Union Fall Meeting. San Francisco, CA.
- \*Nielsdottir, M.C., B. Honisch, S. Rauschenberg, S. Vogt, and B.S. Twining. 2012. The iron requirements of coastal and oceanic strains of *Emilinia huxleyi*. Ocean Carbon & Biogeochemistry Annual Summer Science Workshop. Woods Hole, MA.
- Twining, B.S., and J. Nuester. 2012. Assessing the importance of extracellular iron scavenged on phytoplankton cells with synchrotron x-ray fluorescence microscopy. Goldschmidt Conference. Montreal, Canada.
- \*Nuester, J., S. Vogt, M. Newville, A. Kustka, and B.S. Twining. 2012. The unique biogeochemical signature of the marine diazotroph *Trichodesmium*. Goldschmidt Conference. Montreal, Canada.
- Sherrell, R.M., H. Planquette, M.P. Field, J.K.B. Bishop, T. Wood, P. Lam, B. Twining, and P. Morton. 2011. Collection and determination of suspended particulate trace metals: The US GEOTRACES Intercalibration cruises. Goldschmidt Conference. Prague, Czech Republic.
- Twining, B.S., H. Lin, T. Shaw, K. Smith, M. Vernet, R. Kaufmann, J. Helly, A. Murray, and G. Stephenson. 2011. Impacts of free-drifting icebergs on surrounding waters of the Southern Ocean. Modeling and Synthesis of Southern Ocean Natural Iron Fertilization Workshop. Woods Hole, MA.
- Baines, S.B., B.S. Twining, M.A. Brzezinski, J.W. Krause. 2011. A surprising role for picocyanobacteria in the marine silicon cycle. ASLO Aquatic Sciences Meeting. San Juan, PR.
- \*Nielsdottir, M.C., I. Salter, M. Zubkov, P. Warwick, I. Croudance, B. Twining, E. Achterberg. 2010. Iron uptake and storage in in-situ phytoplankton in the Irminger and Iceland Basin during spring and summer. 14<sup>th</sup> Biennial Challenger Conference for Marine Science. Southampton, UK.
- Bucci, V., D. Nunez-Milland, B. Twining, and F. Hellweger. 2010. Combining agent-based modeling and observations of intrapopulation variability in phytoplankton. ASLO Summer Meeting. Santa Fe, NM.
- \*Lin, H., and B.S. Twining. 2010. Impact of free-drifting icebergs on the concentration and speciation of iron in surrounding waters of the Southern Ocean. Ocean Sciences Meeting. Portland, OR.
- Twining, B.S., S.B. Baines, S. Vogt, and D.M. Nelson. 2010. Luxury iron uptake and storage in pennate diatoms from the equatorial Pacific Ocean. Ocean Sciences Meeting. Portland, OR.

- Baines, S.B., B.S. Twining, M.A. Brzezinski, D. Nuñez-Milland, D. Assael, S. Vogt, H. McDaniel, and D.M. Nelson. 2010. A role for picocyanobacteria in the ocean's Si cycle. Ocean Sciences Meeting. Portland, OR.
- \*Hill, L., T.L. Richardson, K. Donaldson, B.S. Twining, T.J. Shaw, M.L. Myrick. 2009. Phytoplankton community characterization using imaging multivariate optical computing (IMOC) and spectra fluorescence signatures. Chapman Conference on the Biological Carbon Pump of the Oceans. Brockenhurst, Hampshire, England.
- Twining, B., D. Nuñez-Milland, S. Vogt, R. Johnson, and P. Sedwick. 2009. Variations in *Synechococcus* cell quotas of phosphorus, sulfur, manganese, iron, nickel and zinc within mesoscale eddies in the Sargasso Sea. Chemical Oceanography Gordon Research Conference. Tilton, NH.
- \*Lin, H., and B. Twining. 2009. Effect of free-drifting icebergs on iron chemistry in the surrounding waters of the Weddell Sea. Chemical Oceanography Gordon Research Conference. Tilton, NH.
- \*Nuñez-Milland, D., B.S. Twining, S.B. Baines, S. Vogt. 2008. Analysis of phytoplankton elemental composition with synchrotron x-ray fluorescence. Synchrotron Environmental Science IV. San Francisco, CA.
- Hill, L.S., L.T.M. Profeta, E. Lawrenz, T.L. Richardson, B.S. Twining, C.J. Hintz, T.J. Shaw, and M.L. Myrick. 2008. Studies of the fluorescence excitation spectroscopy of phytoplankton at the single organism level. Pittsburgh Conference on Analytical Chemistry. New Orleans, LA.
- Profeta, L.T.M., L.S. Hill, E. Lawrenz, T.L. Richardson, B.S. Twining, C.J. Hintz, T.J. Shaw, and M.L. Myrick. 2008. Construction, figures of merit, and testing of a single-plankton fluorescence excitation spectroscopy system. Federation of Analytical Chemistry and Spectroscopy Societies Meeting. Reno, NV.
- Hochella, M.F., Jr., S.K. Lower, P.A. Maurice, R.L. Penn, N. Sahai, D.L. Sparks, and B.S. Twining. 2008. Nanominerals, mineral nanoparticles, and earth systems. Goldschmidt 2008. Vancouver, Canada.
- Twining, B.S., S.B. Baines, S. Vogt, and D. Nelson. 2008. Role of diatoms in nickel biogeochemistry in the Pacific Ocean. Ocean Sciences Meeting. Orlando, FL.
- Baines, S.B., B.S. Twining, S. Vogt. 2008. Are all diatoms the same? Variations in cellular stoichiometry of diatoms from two HNLC regions and their implications for Si, Fe and C export. Ocean Sciences Meeting. Orlando, FL.
- Brzezinski, M.A., D.M. Nelson, B.S. Twining, and S.B. Baines. 2008. Iron and silicon co-limitation in the equatorial Pacific. Ocean Sciences Meeting. Orlando, FL.
- Twining, B., S. Baines, S. Vogt, D. Nelson, and M. Brzezinski. 2007. Elemental composition of plankton in the equatorial Pacific Ocean: Evidence of diatom co-limitation by Fe and Si. Chemical Oceanography Gordon Research Conference. Tilton, NH.
- Twining, B.S., S.B. Baines, and C.A. Vogel. 2007. Phytoplankton trace metal quotas across nutrient gradients in the equatorial Pacific Ocean. Aquatic Sciences Meeting. Santa Fe, NM.
- Baines, S.B., B.S. Twining, C. Vogel, X. Chen, and N.S. Fisher. 2007. Do physiological cascades affect the response of phytoplankton trace element stoichiometries to nutrient limitation? Aquatic Sciences Meeting. Santa Fe, NM.



- Twining, B., S. Mylon, and G. Benoit. 2006. Potential role of Cu availability in nitrous oxide accumulation in a temperate lake. Environmental Sciences: Water Gordon Research Conference. Plymouth, NH.
- Buettner, K., B.S. Twining, and S.E. Mylon. 2006. Potential Cu limitation of denitrification by inorganic polysulfide clusters. American Chemical Society National Meeting. Atlanta, GA.
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- Twining, B.S. and S.B. Baines. 2006. Response of plankton trace element quotas to iron gradients in the Equatorial Pacific Ocean. Ocean Sciences Meeting. Honolulu, HI.
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- Twining, B.S., S.B. Baines, and N.S. Fisher. 2005. Quantifying trace elements in individual nanoplankton cells with synchrotron-based x-ray fluorescence. Symposium on Single-cell Analysis of Planktonic Microbes. Banyuls-sur-mer, France.
- Twining, B., S. Baines, and N. Fisher. 2005. Exploring stoichiometric responses of Southern Ocean plankton to iron fertilization using synchrotron-based x-ray fluorescence microscopy. International Ocean Research Conference. Paris, France.
- Twining, B.S., S.E. Mylon, and G. Benoit. 2005. Potential Cu limitation of denitrification by reduced sulfur species in natural waters. American Chemical Society National Meeting. San Diego, CA.
- Twining, B., S. Baines, N. Fisher, J. Maser, S. Vogt, and C. Jacobsen. 2005. Opening the “black box”: Use of synchrotron based x-ray fluorescence microscopy (SXRF) to study trace elements in aquatic protists. Conference on Future Applications of X-ray Microbeams. Argonne, IL.
- Twining, B.S., S. Mylon, and G. Benoit. 2004. Potential Cu limitation of denitrification by reduced sulfur species in natural waters. Environmental Bioinorganic Chemistry Gordon Research Conference, Lewiston, ME.
- Twining, B.S., S.B. Baines, and N.S. Fisher. 2004. Metal cycling through plankton communities: a single-cell approach using synchrotron-based x-ray fluorescence. CIESM 37<sup>th</sup> Congress, Barcelona, Spain.
- Twining, B.S., S.B. Baines, N.S. Fisher, and M.R. Landry. 2004. Accumulation and remineralization of iron by plankton during the Southern Ocean Iron Experiment. American Society of Limnology and Oceanography Ocean Research Conference, Honolulu, HI.
- Twining, B.S., S.B. Baines, and N.S. Fisher. 2003. Opening the ‘black box’: elemental stoichiometries of autotrophic and heterotrophic protists in the Southern Ocean. American Society of Limnology and Oceanography Aquatic Sciences Meeting, Salt Lake City, UT.
- Twining, B.S., S.B. Baines, N.S. Fisher, and M.R. Landry. 2002. Fe:C ratios within the plankton community during the Southern Ocean Iron Experiment (SOFeX). American Geophysical Union Fall Meeting, San Francisco, CA.
- Twining, B.S., S.B. Baines, N.S. Fisher, C. Jacobsen, and J. Maser. 2002. Quantification and localization of trace metals in natural plankton cells using a synchrotron x-ray fluorescence microprobe. X-ray Microscopy (XRM) 2002 Meeting, Grenoble, France.

- Twining, B.S., M.R. Twiss, and N.S. Fisher. 2002. Bioaccumulation, redox cycling, and trophic transfer of thallium by Great Lakes plankton communities. American Society of Limnology and Oceanography Summer Meeting, Victoria, BC.
- Baines, S.B., B.S. Twining, N.S. Fisher, J. Maser, and C. Jacobsen. 2002. Trace element concentrations and stoichiometries in planktonic protists measured with an x-ray fluorescence microprobe. American Society of Limnology and Oceanography Summer Meeting, Victoria, BC.
- Twiss, M.R., B.S. Twining, and N.S. Fisher. 2002. Biogeochemical cycling of inorganic and organic thallium in Great Lakes plankton communities. Canadian Society for Chemistry Conference, Vancouver, BC.
- Twining, B.S., S.B. Baines, N.S. Fisher, C. Jacobsen, and J. Maser. 2001. Quantification of trace metals in natural plankton using a synchrotron x-ray fluorescence microprobe. Society of Environmental Toxicology and Chemistry Annual Meeting, Baltimore, MD.
- Twining, B.S., M.R. Twiss, and N.S. Fisher. 2001. Bioaccumulation and redox cycling of thallium in Great Lakes plankton communities. Society of Environmental Toxicology and Chemistry Annual Meeting, Baltimore, MD.
- Twining, B.S., S.B. Baines, N.S. Fisher, C. Jacobsen, and J. Maser. 2001. A novel tool for the quantification and localization of trace elements in plankton: synchrotron x-ray fluorescence microprobe. American Society of Limnology and Oceanography Aquatic Sciences Meeting, Albuquerque, NM.
- Twining, B.S. and N.S. Fisher. 2000. Trophic transfer of metals to estuarine zooplankton via grazing on protozoa. Society of Environmental Toxicology and Chemistry Annual Meeting, Nashville, TN.

### **Funding**

- National Science Foundation—"Collaborative Research: Determining the elemental composition of natural plankton cells in the Eastern Equatorial Pacific using synchrotron x-ray fluorescence microscopy" 08/15/05-08/14/08.
- USC Research Foundation—"Magellan Scholar Program: Can sulfur be used as a proxy for carbon biomass in marine phytoplankton?" 01/01/07-5/15/08.
- National Science Foundation—"Collaborative Research: Free-drifting icebergs: Influence of floating islands on pelagic ecosystems in the Weddell Sea" 09/01/07-08/31/11.
- National Science Foundation—"In-situ classification of bloom-forming phytoplankton by imaging multivariate optical computing (IMOC)" 08/15/07-02/14/10.
- National Science Foundation—"Collaborative Research: Agent-based modeling and observation of intra-population variability" 09/01/07-08/31/10.
- National Science Foundation—"Collaborative Research: Iron storage in diatoms and N<sub>2</sub> fixing cyanobacteria" 09/01/07-08/31/12.
- National Science Foundation—"Collaborative Research: FeCycle II: Natural variability in plankton iron quotas" 08/15/08-07/31/10.
- National Science Foundation—"Acquisition of a confocal laser scanning microscope at the Bigelow Laboratory for Ocean Sciences" 09/15/09-08/31/13.
- National Science Foundation—"GEOTRACES Atlantic Section: Characterization of phytoplankton trace metal quotas and their contribution to the particulate metal pool in the upper ocean" 01/01/10-06/31/13.

National Science Foundation—“Collaborative Research: The Great Southern Coccolithophore Belt” 06/15/10-05/31/14.

National Science Foundation—“A Center for Ocean Biogeochemistry and Climate Change: Addressing the Role of Plankton in Ocean and Climate Change” 10/01/10-09/30/13.

National Science Foundation—“Assessing the chemical speciation and bioavailability of iron regenerated by marine zooplankton” 04/01/11-03/31/14.

National Science Foundation—“EAGER: Characterizing biological function across a persistent oceanographic “hotspot” in the NE Pacific Ocean” 01/01/12-12/31/12.

National Science Foundation—“Collaborative Research: Understanding the role of picocyanobacteria in the marine silicate cycle” 01/01/12-12/31/14.

National Science Foundation—“GEOTRACES Pacific Section: Characterizing biogenic trace elements across productivity and oxygen gradients in the eastern South Pacific” 10/1/12-9/30/15.

National Science Foundation—“FSML—Enhanced cooperative radiochemistry research and education at the Bigelow Laboratory for Ocean Sciences” 09/15/13-08/31/16.

National Science Foundation—“Collaborative Research: Investigating the ecological importance of iron storage in diatoms” 08/01/13-07/31/16.

National Science Foundation—“GEOTRACES Arctic Section: Collaborative Research: Biogeochemical cycling of particulate trace elements in the western Arctic basin” 09/01/14-08/31/17.

National Science Foundation—“Collaborative Research: Regional variation of phytoplankton diversity and biogeochemical functioning in the subtropical Indian Ocean” 01/01/16-12/31/17.

National Science Foundation—“MRI: Acquisition of a quadrupole ICP-MS for research and teaching on marine organisms and biogeochemistry” 09/01/16-08/31/19.

### **Teaching experience**

Program Director, ‘Changing Oceans’ Colby @ Bigelow Semester Program  
 Ocean Biogeochemistry on a Changing Planet (Colby College—BI 385B, CH 385)  
 Climate Change and the Oceans (Colby College—ES 197a)  
 General Chemistry (Univ. South Carolina—CHEM 111)  
 Aquatic Chemistry (Univ. South Carolina—CHEM 624/CHEM 729/MSCI 624)  
 Limnology (Stony Brook University—Teaching assistant)  
 Organismal Biology (Stony Brook University—Teaching assistant)

### **Research cruise experience**

2018 Southern Ocean TimeSeries cruise: 20 days on *R/V Investigator*  
 2015 Line P cruise to Ocean Station Papa: 16 days on *R/V John P. Tully*  
 2014 IronBru cruise in California Current System: 23 days on *R/V Melville*  
 2013 Bermuda Atlantic Time-Series ‘B-Val’ cruise: 7 days on *R/V Atlantic Explorer*  
 2012 GEOMICS cruise: 7 days on the *R/V Thomas G. Thompson*  
 2012 Great Southern Coccolithophore Belt cruise II: 35 days on *R/V Roger Revelle*  
 2011 Great Southern Coccolithophore Belt cruise I: 35 days on *R/V Melville*  
 2010 Bermuda Atlantic Time-Series: 5 days on *R/V Atlantic Explorer*  
 2009 Iceberg III cruise in the Weddell Sea: 40 days on *R/V Nathaniel B. Palmer*  
 2008 FeCycle II cruise in subtropical waters east of New Zealand: 23 days on *FRV Tangaroa*

- 2008 Iceberg II cruise in the Weddell and Scotia Seas: 30 days on *RVIB Nathaniel B. Palmer*  
2007 Iron in the Sargasso Sea (FeAST-2 cruise): 10 days on *R/V Atlantic Explorer*  
2004 Eastern Equatorial Pacific Biocomplexity cruise: 30 days on *R/V Roger Revelle*  
2002 Southern Ocean Iron Experiment (SOFeX): 41 days on *R/V Roger Revelle*  
2001 Lake Ontario Surveillance cruise: 5 days on *CCGS Limnos*  
2000 Microbial Ecology of the Lake Erie Ecosystem (MELEE): 7 days on *CCGS Limnos*  
1997 CalCOFI cruise: 4 days on *R/V David Starr Jordan* from Pt Conception to San Diego

### **Undergraduate students**

Sarabeth George (Colby College 2015, undergraduate honors thesis)  
Brooke Stemple (UNC Chapel Hill 2015, REU student and undergraduate honors thesis)  
Elyse Walker (Univ. South Carolina, undergraduate researcher)  
Kaitlin Duffey (Univ. South Carolina, undergraduate researcher)

### **Graduate Students**

Hai Lin (PhD 2009)  
Daliangelis Nunez-Milland (MS 2010)  
Allison Dalbec (MS 2008)  
Brandon Bozard (MS 2008)

### **Post-doctoral researchers**

Elizabeth Mann (2016-present)  
Daniel Ohnemus (2014-present)  
Jeremy Jacquot (2013-2015)  
Jochen Nuester (2009-2014)

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