

BETTINA MARGRIT VOELKER

Associate Professor
Department of Chemistry and Geochemistry
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Colorado School of Mines
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Professional Preparation

B.S.: Chemistry, Massachusetts Institute of Technology, 1989.

M.S.: Civil Engineering, Massachusetts Institute of Technology, 1990. *Thesis title:* An electrostatic model of the metal-binding properties of humic substances.

Ph.D.: Environmental Sciences, Swiss Federal Institute of Technology (ETH) Zurich, Switzerland 1994. *Thesis title:* Iron redox cycling in surface waters: effects of humic substances and light.

Postdoctoral: Woods Hole Oceanographic Institution, Department of Marine Chemistry and Geochemistry. January 1995-June 1996.

Appointments

1988-1990 Teaching assistant and research assistant, Massachusetts Institute of Technology
1991-1992 Teaching assistant, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland.
1990-1994 Research assistant, Swiss Federal Institute for Environmental Science and Technology (EAWAG), Duebendorf, Switzerland.
1/95-6/96 Postdoctoral scholar, Woods Hole Oceanographic Institution
9/95-12/95 Lecturer, Massachusetts Institute of Technology
7/96-6/02 Assistant Professor, Massachusetts Institute of Technology
7/02-7/04 Associate Professor, Massachusetts Institute of Technology
6/97, 6/99, Visiting scientist, Woods Hole Oceanographic Institution
8/00, 6/01, 7/02
8/04-present Associate Professor, Colorado School of Mines
9/10-5/11 Fellow, Radcliffe Institute for Advanced Study, Harvard University

Awards Received

Postdoctoral Scholarship, Woods Hole Oceanographic Institution	1995
Henry and Grace Doherty Professorship in Ocean Utilization	1998-2000
Gilbert Winslow Career Development Chair	2001-2002
Fellowship, Radcliffe Institute for Advanced Study	2010-2011

Current Organization Memberships

American Chemical Society	1991-present
Association of Environmental Engineering and Science Professors	1998-present
American Geophysical Union	2000-present
American Society of Limnology and Oceanography	2004-present

Peer-reviewed Publications

- Bartschat (Voelker), B.M., Cabaniss, S.E., and Morel, F.M.M. "Oligoelectrolyte model for cation binding by humic substances", *Environmental Science and Technology*, 26, 284-294, 1992.
- Voelker, B.M. and Sedlak, D.L. "Iron reduction by photoproduced superoxide in seawater", *Marine Chemistry (Special Issue: The Chemistry of Iron in Seawater and its Interaction with Phytoplankton)*, 50, 93-102, 1995.
- Voelker, B.M. and Sulzberger, B. "Effects of fulvic acid on Fe(II) oxidation by hydrogen peroxide", *Environmental Science and Technology*, 30, 1106-1114, 1996.
- Voelker, B.M., Morel, F.M.M. and Sulzberger, B. "Iron redox cycling in surface waters: effects of humic substances and light", *Environmental Science and Technology*, 31, 1004-1011, 1997.
- Zafiriou, O.C, Voelker, B.M. (*corresponding author*), and Sedlak, D.L. "Chemistry of the superoxide radical (O_2^-) in seawater: reactions with inorganic copper complexes," *J. Phys. Chem. A*, 102, 5693-5700, 1998.
- Voelker, B.M., Sedlak, D.L., and Zafiriou, O.C. "Chemistry of the superoxide radical (O_2^-) in seawater: reactions with organic copper complexes." *Environ. Sci. Technol.*, 34, 1036-1042, 2000
- Goldstone, J. V. ** and Voelker, B.M. "Chemistry of the superoxide radical (O_2^-) in seawater: CDOM associated sink of superoxide in coastal waters." *Environ. Sci. Technol.*, 34, 1043-1048, 2000.
- Kogut, M.B. ** and Voelker, B.M. "Strong copper binding behavior of terrestrial humic substances in seawater." *Environ. Sci. Technol.*, 35(6), 1149-1156, 2001.
- Voelker, B.M. and Kogut, M.B. ** "Interpretation of metal speciation data in coastal waters: the effects of humic substances on copper binding as a test case." *Marine Chemistry*, 74(4), 303-318, 2001.
- Scott, D.T., McKnight, D.M., Hrncir, D.C., and Voelker, B.M. "Manganese transport and cycling in a mountain stream." *Environ. Sci. Technol.*, 36, 453-459, 2002.

** students supervised by B.M. Voelker

* postdoc supervised by B.M. Voelker

Peer-reviewed Publications (continued)

- Goldstone, J.V. **, Pullin, M.J. *, Bertilsson, S., and Voelker, B.M. "Hydroxyl radical reactions with humic substances: bleaching, mineralization, and production of bioavailable carbon substrates." *Environ. Sci. Technol.*, 36, 364-372, 2002.
- Kwan, W.P. ** and Voelker, B.M. "Decomposition of hydrogen peroxide and organic compounds in the presence of dissolved iron and ferrihydrite." *Environ Sci Technol.*, 36, 1467-1476, 2002.
- Kogut, M.B. ** and Voelker, B.M. "Kinetically inert Cu in coastal waters." *Environ. Sci. Technol.*, 37, 509-518, 2003.
- Southworth, B.A. ** and Voelker, B.M. "Hydroxyl radical production via the photo-Fenton reaction in the presence of fulvic acid." *Environ. Sci. Technol.*, 37, 1130 – 1136, 2003.
- Kwan, W.P. ** and Voelker, B.M. "Rates of hydroxyl radical generation and organic compound oxidation in mineral-catalyzed Fenton-like systems." *Environ. Sci. Technol.*, 37, 1150 – 1158, 2003.
- Scott, D.T., Runkel, R.L., McKnight, D.M., Voelker, B.M., Kimball, B.A. and Carraway, E.R. "Transport and Cycling of Iron and Hydrogen Peroxide in a freshwater stream: influence of organic acids", *Water Resources Research*, 39(11), Art. No. 1308, 2003.
- Kwan, W.P. ** and Voelker, B.M. "Influence of electrostatics on the oxidation rates of organic compounds in heterogeneous Fenton systems", *Environ. Sci. Technol.*, 38, 3425-3431, 2004.
- Goldstone, J.V. **, del Vecchio, R., Blough, N.V., and Voelker, B.M. "A multi-component model of chromophoric dissolved organic matter (CDOM) photo-bleaching," *Photochemistry and Photobiology*, 80(1), 52-60, 2004.
- Pullin, M. J. *, Bertilsson, S., Goldstone, J.V. ** and Voelker, B.M. "Effects of sunlight and hydroxyl radical on dissolved organic matter: Bacterial growth efficiency and production of carboxylic acids and other substrates." *Limnol. Oceanogr.*, 49(6), 2011–2022, 2004.
- Fisher, M.B. **, Keenan, C.R. **, Nelson, K.L., Voelker, B.M. "Speeding up solar disinfection (SODIS): effects of hydrogen peroxide, temperature, pH, and copper plus ascorbate on the photoinactivation of *E. coli*." *Journal of Water and Health*, 6(1), 35-51, 2008.
- Hansard, S.P. *, Landing, W.M., Measures, C.I., and Voelker, B.M. "Dissolved iron (II) in the Pacific Ocean: Measurements from the PO2 and P16N CLIVAR/CO₂ repeat hydrography expeditions." *Deep-Sea Research I*, 56(6), 1117-1129, 2009.
- Vermilyea, A.W.** and Voelker, B.M. "Photo-Fenton reaction at near-neutral pH." *Environmental Science and Technology*, 43(18), 6927–6933, 2009.

** students supervised by B.M. Voelker

* postdoc supervised by B.M. Voelker

Peer-reviewed Publications (continued)

Vermilyea, A.W. **, Hansard, S.P. * and Voelker, B.M. Dark production of hydrogen peroxide in the Gulf of Alaska. *Limnology and Oceanography*, 55(2), 580-588, 2010.

Vermilyea, A.W. **, Dixon, T.C. ** and Voelker, B.M. Use of H₂¹⁸O₂ to measure absolute rates of dark H₂O₂ production in freshwater systems. *Environ. Sci. Technol.*, 44(8), 3066-3072, 2010.

Hansard, S.P. *, Vermilyea, A.W. **, and Voelker, B.M. Measurements of superoxide radical concentration and decay kinetics in the Gulf of Alaska. *Deep-Sea Research Part I*, 57(9), 1111-1119, 2010.

Learman, D.R., Voelker, B.M., Vazquez-Rodriguez, A.I. and Hansel, C.M. Formation of manganese oxides by bacterially produced superoxide. *Nature Geosciences*, in press.

Hansard, S.P. *, Easter, H.D. **, and Voelker, B.M. Rapid reaction of nanomolar Mn(II) with superoxide radical (O₂⁻) in seawater and simulated freshwater. *Environ. Sci. Technol.*, in press.

Other publications

Maag, B. **, Boning, D. and Voelker, B. "Assessing the Environmental Impact of Copper CMP." *Semiconductor International*, 23(12), 101-102, 2000.

Conference presentations/abstracts

Invited conference presentations

“Iron reduction by photoproduced superoxide in seawater.” Co-author D.L. Sedlak. Talk presented at Workshop on Iron Speciation and its Biological Availability in Seawater, Bermuda, May 1994.

“Iron-oxide catalyzed oxidation of organic compounds by hydrogen peroxide.” Co-authors Southworth, B.A. **, and Kwan, W.P. **. Talk presented at Eleventh Annual V.M. **Goldschmidt Conference**, Hot Springs, Virginia, May 2001.

"A tale of two transients: roles of aqueous superoxide and hydroxyl radicals in environmental redox processes." Talk presented at **Gordon Research Conference** in Environmental Sciences: Water. Holderness School, NH, June 2002.

Other oral conference presentations

Voelker, B.M. and Sulzberger, B. “The role of humic substances in iron photo-redox cycling.” Conference on Humic Substances in the Environment, Georgia Institute of Technology, Atlanta, GA, August 1995.

Voelker, B.M., Zafiriou, O.C. and Sedlak, D.L. “Metal redox cycling by photoproduced superoxide radical.” 210th American Chemical Society National Meeting, Environmental Chemistry Division, Chicago, IL, August 1995.

Sedlak, D.L., Voelker, B.M., Zafiriou, O.C., Abu-Saba, K.E., and Flegal, A.R. “Superoxide radical and the photoredox chemistry of copper and chromium.” Society of Environmental Toxicology and Chemistry 18th Annual Meeting, San Francisco, CA, November 1997.

Voelker, B.M. and Goldstone J.V. ** “CDOM associated sink of superoxide in coastal waters.” 216th American Chemical Society National Meeting, Environmental Chemistry Division, Boston, MA, August 1998.

Voelker, B.M. “The multiple personalities of humic acid.” 216th American Chemical Society National Meeting, Society Committee on Education, Boston, MA, August 1998.

Voelker, B.M. and Ho, Sharon W. ** “The Effect of Fe on the Rates of Photobleaching of Dissolved Organic Matter.” 19th Annual Meeting of the Society for Environmental Toxicology and Chemistry, Charlotte, NC, November 1998.

Voelker, B.M. and Kogut, M.B. ** “Interpreting metal complexation data in coastal waters.” 220th American Chemical Society National Meeting, Environmental Chemistry Division, Washington, DC, August 2000.

** students supervised by B.M. Voelker

* postdoc supervised by B.M. Voelker

Conference presentations/abstracts (continued)

Scott, D.T., McKnight, D.M., Hrncir, D.C., and Voelker, B.M. "Manganese cycling in mountain streams." 220th American Chemical Society National Meeting, Environmental Chemistry Division, Washington, DC, August 2000.

Pullin, M.J.* and Voelker, B.M. "The use of liquid chromatography-mass spectrometry to measure organic DOM photoproducts." Pacificchem 2000, Honolulu, Hawaii, December, 2000.

Southworth, B.A.** , Voelker, B.M., and Gschwend, P.M. "Hydrogen peroxide cycling and hydroxyl radical formation in an iron- and DOC-rich lake." Pacificchem 2000, Honolulu, Hawaii, December, 2000.

Goldstone, J.V.** , Pullin, M.J.* and Voelker, B.M. "Reactions of hydroxyl radical (OH) with chromophoric dissolved organic matter (CDOM): Bleaching and Mineralization." 2002 Ocean Sciences Meeting, Honolulu, Hawaii, February 2002.

Pullin, M.J.* , Goldstone, J.V.** , Bertilsson, S., and Voelker, B.M. "Is the photoproduction of low molecular weight organic acids the primary mechanism for increasing the bioavailability of dissolved organic matter?" 2002 Ocean Sciences Meeting, Honolulu, Hawaii, February 2002.

Goldstone, J.V.** , Del Vecchio, R., Blough, N.V. and Voelker, B.M. "A multi-component model of the photo-bleaching of chromophoric dissolved organic matter." 225th American Chemical Society National Meeting, Environmental Chemistry Division, New Orleans, LA, March 2003.

Voelker, B.M. and Kwan, W.P.** "Predicting oxidation rates of dissolved contaminants during *in situ* remediation using Fenton's reaction." 4th International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA, May 2004.

Kwan, W.P. and Voelker, B.M. "Predicting oxidation rates of dissolved contaminants during *in situ* remediation using Fenton's reaction." 228th American Chemical Society National Meeting, Environmental Chemistry Division, Philadelphia, PA, August 2004.

Voelker, B.M., Southworth, B.A.** , Pullin, M.J.* , Goldstone, J.V.** and Bertilsson, S. "Hydroxyl radical produced by Fenton's reaction: its importance as a sink of recalcitrant organic compounds in freshwater." American Society of Limnology and Oceanography Aquatic Sciences Meeting, Salt Lake City, UT, February 2005.

Pullin, M.J.* , Bertilsson, S., Goldstone, J.V.** and Voelker, B.M. "Effects of sunlight on DOM: Bacterial growth efficiency and carboxylic acid utilization." American Society of Limnology and Oceanography Aquatic Sciences Meeting, Salt Lake City, UT, February 2005.

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* postdoc supervised by B.M. Voelker

Conference presentations/abstracts (continued)

- Vermilyea, A.W.** and Voelker, B.M. “Photo-Fenton reaction at neutral pH in a fulvic acid solution.” 233rd American Chemical Society National Meeting, Geochemistry Division, Chicago, IL, March 2007.
- Hansard, S.P.* , Vermilyea, A.W.** , Easter, H.D.** and Voelker, B.M. “Superoxide sources and sinks in the Gulf of Alaska”. American Society of Limnology and Oceanography Ocean Sciences Meeting 2008, Orlando, Florida, March 2008.
- Hansard, S.P.* and B.M. Voelker, 2009. “Factors governing the lifetime of superoxide radical in seawater.” Frank Millero Honorary Symposium on Kinetics and Speciation, American Chemical Society National Meeting 2009, Salt Lake City, Utah, March 2009.
- Easter, H.D.** , B.M. Voelker, and S.P. Hansard* . “Kinetics of reactions of superoxide with manganese in simulated natural waters.” American Chemical Society NORM Meeting 2009, Tacoma, WA. June, 2009.
- Hansard, S.P.* , Easter, H.D.** and Voelker, B.M. “Kinetics of oxidation of manganese(II) by superoxide in natural waters.” American Chemical Society National Meeting 2010, San Francisco, CA, March 2010.

Other conference presentations - Posters

- Green, S.A., Bartschat (Voelker), B.M. and Morel, F.M.M. “Electrostatic properties of humic substances.” Gordon Research Conference in Environmental Chemistry: Water, New Hampton, NH, June 1990.
- Bartschat (Voelker), B.M., Cabaniss, S.E. and Morel, F.M.M. “An oligoelectrolyte model for metal binding by humic substances.” Interfacial Phenomena in the Environment, Davos, Switzerland, October 1991.
- Bartschat (Voelker), B.M. and Sulzberger, B. “The role of humic substances in natural water iron cycling.” 203rd American Chemical Society National Meeting, Geochemistry Division, San Francisco, CA, April 1992.
- Voelker, B.M. and Sulzberger, B. “Photochemical iron cycling in natural waters.” European Photochemical Association Workshop in Environmental Photochemistry, Adelboden, Switzerland, October 1993.
- Voelker, B.M. and Sulzberger, B. “Photochemical iron cycling in natural waters.” European Research Conference on Rates in Natural Waters and Water Technology, Acquafredda di Maratea, Italy, November 1993.
- Voelker, B.M., Zafiriou, O.C., Moffett, J.W. and Sedlak, D.L. “Reactions of superoxide radical with Cu species in seawater.” Gordon Research Conference in Environmental Chemistry: Water, New Hampton, NH, June 1996.

** students supervised by B.M. Voelker * postdoc supervised by B.M. Voelker

Conference presentations/abstracts (continued)

- Goldstone J.V. ** and B.M. Voelker. "CDOM associated sink of superoxide in coastal waters." Gordon Research Conference in Environmental Chemistry: Water, New Hampton, NH, June 1998.
- Goldstone, J.V. ** and Voelker, B.M. "Iron effects on photo-bleaching of dissolved organic matter in coastal waters." 2000 Ocean Sciences Meeting, San Antonio, TX, January 2000.
- Kwan, W.P. ** and Voelker, B.M. "Heterogeneous Fenton-like chain reactions initiated by iron oxides." 220th American Chemical Society National Meeting, Environmental Chemistry Division, Washington, DC, August 2000.
- Kogut, M.B. ** and Voelker, B.M. "Strong copper binding by terrestrial humic acids in seawater." 220th American Chemical Society National Meeting, Environmental Chemistry Division, Washington, DC, August 2000.
- Goldstone, J.V. ** and Voelker, B.M. "Iron effects on the photochemistry of chromophoric dissolved organic matter in estuarine water." Pacificchem 2000, Honolulu, Hawaii, December, 2000.
- Goldstone, J.V. **, Blough, N.V., del Vecchio, R., and Voelker, B.M. "A multi-component model of chromophoric dissolved organic matter (CDOM) bleaching." 2002 Ocean Sciences Meeting, Honolulu, Hawaii, February 2002.
- Kogut, M.B. ** and Voelker, B.M. "Inert copper in coastal waters." Inaugural Gordon Research Conference in Environmental Bioinorganic Chemistry, Proctor Academy, Andover, NH, June 2002.
- Pullin, M.J. *, Bertilsson, S., Goldstone, J.V. ** and Voelker, B.M. "Photo-induced changes in dissolved organic matter bioavailability: formation of low molecular weight organic acids and other substrates by sunlight and hydroxyl radical." Gordon Research Conference in Environmental Sciences: Water. Holderness School, NH, June 2002.
- Fitzmaurice, A.G. ** and Voelker, B.M. "A temporal and spatial analysis of kinetically inert copper in Boston Harbor." American Society of Limnology and Oceanography International Meeting, Santiago de Compostela, Spain, June 2005.
- Fisher, M.B. **, Voelker, B.M. and Nelson, K.L. "Solar disinfection: effects of hydrogen peroxide, temperature, and copper plus ascorbate on the photoinactivation of *E. coli*." Pacificchem 2005, Honolulu, Hawaii, December 2005.
- Vermilyea, A.W. **, Hansard, S.P. *, and Voelker, B.M. "Sources and sinks of hydrogen peroxide in the Gulf of Alaska." American Society of Limnology and Oceanography Ocean Sciences Meeting 2008, Orlando, Florida, March 2008.

** students supervised by B.M. Voelker

* postdoc supervised by B.M. Voelker

Conference presentations/abstracts (continued)

- Voelker, B.M., Hansard, S.P.^{*}, Easter, H.D.^{**}, Slatter, J.^{**} and Vermilyea, A.W.^{**}
“Superoxide detection and reactions in natural waters.” Gordon Research Conference in Environmental Sciences: Water. Holderness School, NH, June 2008.
- Voelker, B.M., Hansard, S.P.^{*}, Easter, H.D.^{**}, Slatter, J.^{**} and Vermilyea, A.W.^{**}
“Superoxide detection and reactions in natural waters.” American Society of Limnology and Oceanography Summer Meeting 2008, Saint John’s, Newfoundland, Canada, June 2008.
- Hansard, S. P.^{*} and Voelker, B.M. “Evidence for rapid metal reactions with superoxide radical in seawater.” Gordon Research Conference in Chemical Oceanography, Tilton, New Hampshire, August 2009.
- Vermilyea, A.W.^{*} and Voelker, B.M. “Photo-Fenton reaction at neutral pH.” American Chemical Society National Meeting 2010, San Francisco, CA, March 2010.
- Hansard, S.P.^{*}, Easter, H.D.^{**} and Voelker, B.M. “Mn(II) oxidation by superoxide radical.” Gordon Research Conference in Environmental Sciences: Water, Plymouth, New Hampshire, June 2010.
- Dixon, T.E.^{**}, Vermilyea, A.W.^{**}, Scott, D.T. and Voelker, B.M. “Biological hydrogen peroxide production in an agricultural headwater stream.” Gordon Research Conference in Environmental Sciences: Water, Plymouth, New Hampshire, June 2010.

^{**} students supervised by B.M. Voelker

^{*} postdoc supervised by B.M. Voelker

Invited lectures at academic institutions

Swiss Federal Institute for Environmental Science and Technology (EAWAG), Dübendorf, Switzerland, January 1990.

Institute for Terrestrial Ecology, Schlieren, Switzerland, November 1991.

Woods Hole Oceanographic Institution, Woods Hole, MA, January 1994.

Colby College, Waterville, ME, January 1994.

Max-Planck-Institute für Chemie, Mainz, Germany, May 1994.

Massachusetts Institute of Technology, Cambridge, MA, February 1995.

California Institute of Technology, Pasadena, CA, February 1995

University of California, Berkeley, CA, April 1996.

University of Massachusetts, Boston, MA, May 1997.

University of Maryland, College Park, MD, September 1998.

Johns Hopkins University, Baltimore, MD, September, 1998.

Boston University, Boston, MA, April 2000.

Princeton University, Princeton, NJ, September 2000.

MIT Department of Earth, Atmospheric, and Planetary Sciences, September 2000

University of Colorado, Boulder, CO, November 2000

University of Massachusetts, Amherst, MA, April 2001.

Annual Symposium on Chemistry and Biochemistry, University of North Carolina at Wilmington, January 2002.

Duke University, Raleigh, NC, January 2002.

Cornell University, Ithaca, NY, March 2002.

University of California, Berkeley, CA, April 2002.

California Institute of Technology, Pasadena, CA, April 2002.

University of Minnesota, Minneapolis, MN, May 2002.

Invited lectures at academic institutions (continued)

University of Rhode Island, Kingston, RI, March 2002.

University of Notre Dame, South Bend, IN, May 2003.

Northwestern University, Evanston, IL, May 2003

University of Wisconsin, Madison, WI, May 2003

University of California at Riverside, March, 2004

University of Arizona, March 2004

Colorado School of Mines, Department of Chemistry and Geochemistry, March 2004.

Colorado School of Mines, Department of Environmental Science and Engineering,
September 2004.

University of Colorado, Boulder, CO, April 2005.

New Mexico Tech, Socorro, NM, October 2005.

University of New Mexico, Albuquerque, NM, October 2005.

University of Wyoming, Laramie, WY, November 2006.

University of Wyoming, Laramie, WY, February 2007.

Harvard University, Cambridge, MA, December 2009.

Record of Research Funding

1996-1998	National Science Foundation (NSF) Chemical Oceanography Program <i>Effects of superoxide on copper and iron speciation in marine systems.</i> Co-Principal Investigator.	\$114,500
1997-1998	Alliance for Global Sustainability <i>Effects of increased UV-B radiation and CDOM photo-oxidation on phytoplankton productivity and community structure in freshwater ecosystems.</i> Co-Principal Investigator.	\$50,000
1997-1999	National Institute of Health <i>Aberjona Watershed Feasibility Study: Speciation and mobility of chromium in the Aberjona watershed.</i> Sole principal investigator.	\$33,800
1998-2000	Sea Grant <i>Effects of terrestrial organic matter on the speciation of Cu and Cd in coastal waters.</i> Sole principal investigator.	\$50,000
1999-2002	NSF, Chemical Oceanography Program <i>Photo-oxidation and photo-bleaching of colored dissolved organic matter in coastal waters.</i> Sole principal investigator.	\$290,000
2000-2002	Petroleum Research Fund, American Chemical Society <i>Rates and mechanisms of iron-catalyzed decomposition of hydrogen peroxide.</i> Sole principal investigator.	\$60,000
2001-2002	Massachusetts Water Resources Research Center. <i>Sources and behavior of copper-binding compounds in rivers and estuaries.</i> Sole principal investigator.	\$24,000
2002-2004	Sea Grant <i>Modeling copper complexation in coastal waters.</i> Sole principal investigator.	\$142,000
2002-2004	International Copper Association <i>Modeling copper complexation in coastal waters (matching funds for Sea Grant project).</i> Sole principal investigator.	\$30,000

Record of Research Funding (continued)

- 2002-2003 National Institute of Health \$25,000
MIT Center for Environmental Health Sciences Pilot Project: Roles of reactive oxygen species in the solar disinfection of water. Sole principal investigator.
- 2006-2009 National Science Foundation \$434,000
Chemical Oceanography Program
Superoxide radical reactions in seawater. Sole principal investigator.
- 2007-2010 National Science Foundation \$134,000
Geobiology and Low-Temperature Geochemistry Program
Collaborative Research: In Situ Examination of Hydrogen Peroxide Sources and Sinks in a Slightly Alkaline Stream. Sole principal investigator of CSM portion of proposal. An additional \$116,000 was awarded to collaborator Durelle Scott of Virginia Tech.
- 2010-2013 National Science Foundation \$249,000
Geobiology and Low-Temperature Geochemistry Program
Collaborative Research: Biological Production of Reactive Oxygen Species in Freshwater. Sole principal investigator of CSM portion of proposal. An additional \$252,000 was awarded to collaborator Colleen Hansel of Harvard University.
- 2010-2011 Radcliffe Institute for Advanced Study at Harvard University \$75,000
Do aquatic organisms use reactive oxygen species to manipulate their geochemical environment? Fellowship for sabbatical salary support plus research and moving expenses.

Student supervision

Undergraduate supervision

Pre-freshmen (through MIT's Research Summer Institute program)

Filip Ilievski, Wenzheng Yeo

Bachelor's theses:

Fitzmaurice, Arthur (MIT), "A protocol for collecting and analyzing field samples for determination of inert copper content", May 2003

Keenan, Christy (MIT), "Additives to improve solar disinfection of drinking water," May 2003

Senior projects (equivalent to Bachelor's theses):

Martinez, Jimmy (MIT), "Investigating the Biotic Ligand Model", May 2001

Poole, Barika (MIT), "Assessing copper speciation and complexation in natural waters", May 2001

Cable, Lorraine (MIT), "Stimulating solar disinfection of water", May 2002

Figueroa, Ramona (CSM), in progress.

Slatter, Joanne (CSM), "MCLA detection of superoxide: method interferences", June 2008

Other undergraduate researchers (MIT):

Arthur Fitzmaurice, Jessica Fox, Kathryn Jeffries, Linda Liang, Joanna Maldonado, Philip Miller, Maria Sisneros, Melanie Wong

Master of Science Theses

Kwan, Wai, "Kinetics of the Fe(III) initiated decomposition of hydrogen peroxide: experimental and model results", August 1999

Kogut, Megan, "Strong copper binding by humic substances in seawater", May 2000

Fitzmaurice, Arthur, "Sources and behavior of inert copper in Boston Harbor," September 2004

Fisher, Michael, "Mechanisms of solar disinfection of drinking water," September 2004.

Easter, Hillary (CSM), "Superoxide reactions with manganese," May 2009.

Dixon, Taylor (CSM), "Hydrogen peroxide cycling in a Nebraska stream," May 2010.

Student supervision (continued)

Master of Engineering Theses

- Baker, Daniel, "Fenton's reagent as an *in-situ* remediation technique", May 1997
- Morange, Arnaud, "Transport of phosphorus in a sewage plume", May 1997
- Ho, Sharon, "The effect of iron on the photo-oxidation of humic substances", May 1998
- Maag, Benoit, "The environmental impact of copper CMP (chemical-mechanical planarization)", May 2000
- Flores, Xanat (co-advisor), "Feasibility of a continuous (or semi-continuous) solar disinfection system for developing countries at a household level", May 2003
- Green, Hillary (co-advisor), "Effects of carpet dyeing on the surface waters of Nepal", May 2003
- Tabbal, Georges (co-advisor), "Societal acceptance of household-scale drinking water disinfection techniques in rural Nepal", May 2003
- Machairas, Alexandros, "Oxidation of organophosphates by hydroxyl radical produced during drinking water disinfection", May 2004

Doctoral Theses supervised

- Goldstone, Jared (WHOI/MIT Joint Program), "Direct and indirect photoreactions of chromophoric dissolved organic matter: roles of reactive oxygen species and iron", December 2001
- Kogut, Megan (CEE), "Copper speciation in estuaries and coastal waters", May 2002
- Southworth, Barbara (CEE), "The role of Fenton's reaction as a source of hydroxyl radical in natural waters", August 2002
- Kwan, Wai (CEE), "Mechanisms of Fenton-like reactions on iron oxide surfaces", May 2003
- Vermilyea, Andrew (CSM), "Hydrogen peroxide in natural waters", September 2009.
- Schneider, Robin (CSM), in progress.
- Marsico, Ryan (CSM), in progress.

Student Supervision (continued)

Doctoral Theses, Reader

- Swartz, Chris (CEE), "Laboratory and field studies of colloid mobilization in a southeastern coastal plain", February 1998.
- Cerefice, Gary (NucE), "Environmental behavior of hafnium: the impact on the disposition of weapons-grade plutonium", July 1999
- White, Sheri (WHOI JP), "Investigations into the sources and controls of light emission at deep-sea hydrothermal vents", April 2000
- Reppert, Philip (EAPS), "Electrokinetics in the earth", May 2000
- Senn, David (CEE), "Coupled nitrogen, iron, and arsenic cycling in a nitrogen- and arsenic-polluted eutrophic lake", November 2000
- Saito, Makoto, (WHOI JP), "The biogeochemistry of cobalt in the Sargasso Sea", November 2000
- Scott, Durelle (CEE, University of Colorado, Boulder), "Metal cycling in mountain streams: manganese and iron fate and transport," October 2001
- Keon, Nicole (CEE), "Arsenic Distribution and Mobility in the Wells G & H Wetland, Woburn, Massachusetts", July 2002
- Cruse, Anna (WHOI JP), "Organic chemistry of hydrothermal vent fluids from the northern Juan de Fuca Ridge", October 2002
- Bergquist, Bridget (WHOI JP), "The marine geochemistry of iron isotopes", July 2004
- Kalnejais, Linda (WHOI JP), "Benthic metal fluxes in the coastal zone", July 2005
- Sarah Stetson (CSM), "Using Stable isotopes to evaluate mercury and mine pollution", May 2009.
- Jean Morrison (CSM), "Weathering, transport, and bioaccessibility of chromium and nickel in soils derived from ultramafic rocks in northern California", May 2010
- Kelly Chipps (CSM), "First Direct Measurement of the Astrophysically Important $^{17}\text{F}(\text{p},\gamma)^{18}\text{Ne}$ Cross Section", May 2008.
- Michael Fisher (UC Berkeley), in progress.
- Kennda Lynch (CSM), in progress.
- Divakara Soorly-Gopala (CSM), "Polyoxometalates for heterogeneous catalysis: exploring various supports and their effects on chemical reactions," May 2010
- Kristin Mikkelson (CSM), in progress.
- Asitha Cooray (New Mexico Tech), in progress.
- Valerie Stucker (CSM), in progress.
- Denise Mitrano (CSM), in progress.

CEE = MIT Dept. of Civil and Environmental Engineering NucE = MIT Dept of Nuclear Engineering
WHOI JP = Woods Hole Oceanographic Institution/MIT Joint Program in Chemical Oceanography
EAPS = MIT Dept. of Earth, Atmospheric and Planetary Sci. CSM = Colorado School of Mines

Postdoctoral supervision

Pullin, Michael. January 2000-June 2002.

Bjorklund-Blom, Lena. September 2002 – March 2003.

Hansard, Stuart Paul. February 2007 – August 2009.

Teaching Experience

MIT, Department of Civil and Environmental Engineering

Aquatic Chemistry. Sole lecturer. Fall Terms 1995, 1996, 1997, 1998, 1999, 2001, 2002. Spring Term 2004. Introductory graduate-level subject emphasizing a quantitative equilibrium approach to understanding and modeling the chemical composition of aquatic systems. Most recent teaching rating ("overall instructor quality" category): 6.5/7.0

Environmental Chemical Kinetics. Sole lecturer. Spring Terms 1997, 1999. Advanced graduate-level subject for students in environmental engineering and chemical oceanography, discussing rates and mechanisms of chemical reactions important in environmental aquatic systems. The class included both a lecture format and discussions of current literature.

Aquatic Chemistry Laboratory. Co-taught (50%). Spring Term 1998. Undergraduate subject focusing on techniques for analyzing important chemical and biological parameters of aquatic systems.

Environmental Chemistry and Biology and Environmental Chemistry and Biology Laboratory. Co-taught (50%). Spring Terms 2000, 2001, 2002, and 2003. Required classes for environmental engineering majors, introducing applications of basic chemical concepts of equilibrium and kinetics in biogeochemical and engineering contexts. Most recent teaching rating ("overall instructor quality" category): 6.3/7.0

Colorado School of Mines, Department of Chemistry and Geochemistry

Analytical Chemistry and Analytical Chemistry Laboratory. Sole lecturer, Fall Terms 2004 and 2006. Laboratory only in fall terms 2005, 2007, 2008 and 2009. Required classes for undergraduate chemistry majors focusing on techniques for quantitative chemical analysis. Most recent teaching rating ("overall instructor quality" category): 3.6/4.0

Environmental Chemistry. Sole lecturer, Spring Term 2005, Fall Term 2005, Spring Terms 2007, 2008 and 2009. Elective for senior chemistry majors. Required class for graduate students in hydrology program. Chemical principles of thermodynamics and kinetics applied to aquatic and atmospheric environmental systems. Most recent teaching rating ("overall instructor quality" category): 3.7/4.0

Principles of Chemistry II. Recitation instructor, Spring term 2005. Freshman chemistry course required of all undergraduates at the School of Mines. (No teaching evaluation performed.)

Environmental Chemical Kinetics. Spring term 2007. Advanced graduate class emphasizing current journal literature.

Aqueous Geochemistry. Sole lecturer, Fall Term 2009. Chemistry elective for Chemical reactions controlling the composition of natural aqueous systems. Equilibrium approaches to acid-base, complexation, precipitation-dissolution and oxidation-reduction reactions; introduction to kinetics.

Service Activities

<u>Activity</u>	<u>Beginning</u>	<u>Ending</u>
<i>Service to MIT's Department of Civil and Environmental Engineering</i>		
Graduate Education and Admissions Committee	9/97	9/02
Organizer, Environmental Chemistry and Biology Seminar Series	9/97	5/03
CEE Alumni Day Planning Committee (received a Presidential Citation Award)	8/99	3/00
Co-taught departmental undergraduate field trip	1/7/03	1/23/03
<i>Other Service to MIT</i>		
Joint Committee on Chemical Oceanography (WHOI/MIT Joint Graduate Program)	9/97	1/99
Faculty advisor to Nightline (MIT's student-run peer counseling service)	6/96	6/01
Organizer, Environmental Perspectives January lecture series	1/98 and 1/99	
Freshman advisor, Terrascope program	9/02	6/05
<i>Service to Colorado School of Mines</i>		
<u>Activity</u>	<u>Beginning</u>	<u>Ending</u>
Geochemistry Program Committee	8/04	present
Hydrology Program Committee	11/04	present
Graduate Council (school-wide committee)	8/04	7/10
Chemistry Lecturer search committee	6/05	8/05
Chemistry Lecturer search committee	1/06	8/06
Chemical Engineering faculty search committee		spring 08
Chemistry Graduate Affairs Committee	4/06	7/10
Chair, Chemistry Graduate Affairs Comm.	6/08	7/10

Professional Service

Symposium organizer, "The role of speciation in trace element fate and transport in natural and polluted waters." Co-sponsored by Geochemistry and Environmental Chemistry divisions of the American Chemical Society, ACS National Meeting, April 1997.

Invited participant and speaker, Biotic Ligand Model workshops bringing together leading representatives from industry, government, and academia to discuss the design of models for predicting metal complexation and toxicity in effluent-receiving waters, and the incorporation of such models into regulatory frameworks. January 2001 and July 2001.

Symposium organizer, "Metal complexation in natural waters". Co-sponsored by Geochemistry and Environmental Chemistry divisions of the American Chemical Society. ACS National Meeting, August 2002.

National Science Foundation panelist, 2006.

Invited participant, National Science Foundation Workshop on Sustainability and Chemistry. May 30-June 1, 2006.

Frequent reviewer for National Science Foundation and *Environmental Science and Technology*. Also reviewer for *Science*, *Nature*, *PNAS*, *Limnology and Oceanography*, *Marine Chemistry*, *Deep Sea Research*, *Geophysical Research Letters*, *Review of Mineralogy and Geochemistry Series*, *Geochimica et Cosmochimica Acta*, *Soil Science of America Journal*, *Water Research*, *Water Resources Research*, *Colloids and Surfaces*, *Journal of Colloid and Interface Science*, *Journal of Physical Chemistry*, *Journal of Solution Chemistry*, *Earth and Planetary Sciences Letters*, *Aquatic Sciences*, *Comparative Biochemistry and Physiology*, and the funding agencies Petroleum Research Fund, United States - Israel Binational Agricultural Research & Development Fund (BARD), Swiss National Science Foundation, Ohio Sea Grant and Maine Space Grant.

Session co-organizer (with Yo Chin), American Society of Limnology and Oceanography Summer Meeting 2008, Saint John's, Newfoundland, Canada.

Invited participant, National Science Foundation Workshop for Future Directions in Geobiology and Low Temperature Geochemistry. August 27-28, 2010.