

CAREY L. FRIEDMAN

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ACADEMIC PREPARATION

PhD: Oceanography, Graduate School of Oceanography - University of Rhode Island (2010)

Dissertation title: Using Passive Samplers to Measure the Bioavailability and Transport of Sedimentary Organic Contaminants. Advisor: Prof. Rainer Lohmann.

MS: Environmental Toxicology, Cornell University (2005)

BS: Chemistry, Trinity College (2002)

EXPERIENCE

POSTDOCTORAL ASSOCIATE, Center for Global Change Science, Joint Program on the Science and Policy of Global Change, Leading Technology and Policy Initiative, and Center for Environmental Health Sciences, Massachusetts Institute of Technology, Cambridge, MA (09/10-present)

Developed 3-D global atmospheric models to investigate the behavior and transport of persistent organic pollutants (POPs), effects of climate change on global POP cycling, and policy implications. Advisor: Dr. Noelle E. Selin.

GRADUATE FELLOW/RESEARCHER, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI (09/08-08/10)

Evaluated the use of passive samplers to measure the bioavailability of polychlorinated dibenzo-*p*-dioxins, polychlorinated dibenzofurans, and polybrominated diphenyl ethers in air, water, and sediment in Newark Bay, New Jersey, near the Diamond Alkali US EPA Superfund site.

GRADUATE RESEARCHER/STUDENT CONTRACTOR, Atlantic Ecology Division, U.S. Environmental Protection Agency, Narragansett, RI (07/06-07/08)

Evaluated the use of passive samplers as biomimetic tools in sedimentary bioaccumulation tests and investigated the effect of sediment resuspension on PCB bioavailability.

INSTRUCTOR, Simmons College, Boston, MA (01/06-05/06)

Taught introductory organic chemistry laboratory to non-majors.

RESEARCHER, Simbiotic Software, Cambridge, MA (10/05-06/06)

Collected data for the distribution of ecology/evolution academic software. Evaluated the effectiveness of software in communicating biological concepts.

GRADUATE FELLOW/RESEARCHER, Environmental Toxicology Program, Cornell University, Ithaca, NY (09/03-08/05)

Measured the degradation kinetics of acetanilide herbicides in wastewater using anodic Fenton treatment.

FIELD SCIENTIST, Casco Bay Estuary Partnership, University of Southern Maine, Portland, ME (07/02-09/02; 07/03-09/03)

Collected sediment and water from the State of Maine for the US EPA's National Coastal Assessment program.

RESEARCH ASSISTANT, IDEXX Laboratories, Westbrook, ME (11/02-7/03)

Developed controlled-release veterinary pharmaceuticals (tilmicosin); screened canine/feline blood for the calibration and manufacture of a veterinary in-clinic laser flow cytometer.

PUBLICATIONS

Journal articles (peer-reviewed):

12. **Friedman, CL**; Pierce, JR; Selin, NE. 2014. Assessing the influence of secondary organic versus primary carbonaceous aerosols on long-range atmospheric PAH transport. *Environ. Sci. Technol.*, 48:3293-3302.
11. **Friedman, CL**; Zhang, Y; Selin, NE. 2014. Climate change and emissions impacts on atmospheric PAH transport to the Arctic. *Environ. Sci. Technol.*, 48:429-437.
10. **Friedman, CL**; Lohmann, R. 2013. Comparing sediment geochemistry and passive sampler techniques to estimate benthic biota PCDD/F concentrations in Newark Bay, New Jersey (U.S.A.). *Environ. Poll.*, 186:172-179.
9. **Friedman, CL**; Selin, NE. 2012. Long-range atmospheric transport of polycyclic aromatic hydrocarbons: A global 3-D model analysis including evaluation of Arctic sources. *Environ. Sci. Technol.*, 46(17): 9501-9510.
8. **Friedman, CL**; Cantwell, MG; Lohmann, R. 2012. Passive sampling provides evidence for Newark Bay as a source of PCDD/Fs to the New York/New Jersey atmosphere. *Environ. Toxicol. Chem.*, 31(2): 253-361.
7. Lambert, MK; **Friedman, CL**; Luey, P; Lohmann, R. 2011. The role of black carbon in the sorption of polychlorinated dibenzo-p-dioxins and dibenzofurans at the Diamond Alkali Superfund site, Newark Bay, NJ. *Environ. Sci. Technol.* 45(10): 4331-4338.
6. Perron, MM; Burgess, RM; Ho, KT; Pelletier, MC; **Friedman, CL**; Cantwell, MG; Shine, JP. 2011. Limitations of reverse polyethylene samplers (RePES) for evaluating toxicity of field contaminated sediments. *Chemosphere*. 83(3): 247-254.
5. **Friedman, CL**; Lohmann, R. Burgess, RM; Perron, MM; Cantwell, MG. 2011. Resuspension of polychlorinated biphenyl-contaminated field sediment: Release to the water column and determination of site-specific K_{DOC} . *Environ. Toxicol. Chem.* 30(2): 377-384.
4. **Friedman, CL**; Burgess, RM; Cantwell, MG; Ho, KT; Lohmann, R. 2009. Comparing polychaete bioaccumulation and passive sampler uptake to assess the effects of sediment resuspension on PCB bioavailability. *Environ. Sci. Technol.* 43(8): 2865-2870.
3. Perron, MM; Burgess, RM; Ho, KT; Pelletier, MC; **Friedman, CL**; Cantwell, MG; Shine, JP. 2009. Development and evaluation of reverse polyethylene samplers for marine phase II whole-sediment toxicity identification evaluations. *Environ. Toxicol. Chem.* 28(4): 749-758.
2. Burgess, RM; Perron, MM; **Friedman, CL**; Suuberg, EM; Pennell, KG; Cantwell, MG; Pelletier, MC; Ho, KT; Serbst, JR; Ryba, SA. 2009. Evaluation of the effects of coal fly ash amendments on the toxicity of contaminated marine sediments. *Environ. Toxicol. Chem.* 28(1): 26-35.

1. **Friedman, CL**; Lemley, AT; Hay, AG. 2006. Degradation of chloroacetanilide herbicides by anodic Fenton treatment. *J. Agric. Food Chem.* 54(7): 2640-2651.

Other publications:

3. **Friedman, CL**; Selin, NE. 2011. Long-range transport of polycyclic aromatic hydrocarbons: A global 3-D model analysis including evaluation of Arctic sources. Report to the MIT Joint Program on the Science and Policy of Global Change.
2. **Friedman, CL**. 2010. Using passive samplers to measure the bioavailability and transport of PCDD/Fs and PBDEs in Newark Bay. Report to the Hudson River Foundation, Grant No. GF/01/09.
1. Derbyshire, E; **Friedman, C**; Grant, A. 2002. Determination of chromium and arsenic in pressurized wood and surrounding soil. *The Trinity Papers*.

PRESENTATIONS

34. **Friedman, CL**, Thackray, C, Selin, NE. Assessing the global and Arctic transport and fate of PCBs using the atmospheric chemical transport model GEOS-Chem (platform). DIOXIN, Madrid, Spain, September 2014.
33. **Friedman, CL**, Selin, NE. Climate change and POPs: air-sea interactions (platform). Invited talk to be given at the Gordon Research Conference: Oceans and Human Health, Biddeford, ME, June 2014.
32. **Friedman, CL**, Pierce, JR, Selin, NE. Assessing the influence of secondary organic aerosols on long-range atmospheric PAH transport (poster). American Geophysical Union Fall Meeting, San Francisco, CA, Dec. 2013.
31. **Friedman, CL**, Zhang, Y, Selin, NE. Climate change and emissions impacts on atmospheric PAH transport to the Arctic (platform). International Symposium on Polycyclic Aromatic Compounds, Corvallis, OR, Sep. 2013.
30. **Friedman, CL**, Zhang, Y, Selin, NE. Influence of future emissions and climate on atmospheric PAH transport (platform). 6th International GEOS-Chem Conference, Cambridge, MA, May 2013.
29. **Friedman, CL**, Selin, NE. Influence of future emissions and climate on PAH transport (poster). American Geophysical Union Fall Meeting, San Francisco, CA, Dec. 2012.
28. **Friedman, CL**, Selin, NE. Influence of future emissions and climate on PAH transport (platform). 33rd annual North American SETAC meeting, Long Beach, CA, Nov. 2012.
27. Selin, NE; **Friedman, CL**. Modeling Arctic contamination by persistent organic pollutants: Informing governance in the context of global change (poster). American Geophysical Union Science Policy Conference, Washington DC, May 2012.
26. **Friedman, CL**; Selin, NE. Long-range transport of PAHs: A global 3D model analysis and evaluation of Arctic sources (platform). International Polar Year, Montreal, Quebec, CA, April 2012.
25. **Friedman, CL**; Selin, NE. Long-range transport of PAHs: A global 3D model analysis and evaluation of Arctic sources. Association of Polar Early Career Scientists (APECS) monthly seminar series, April 2012. Invited virtual poster presentation.
24. **Friedman, CL**. Combining models and measurements to track the fate and transport of persistent organic pollution. Trinity College Chemistry Seminar Series, Hartford, CT, March 2012. Invited talk.

23. **Friedman, CL**. Global atmospheric transport of PAHs: Model evaluation and implications for policy. URI Graduate School of Oceanography Marine and Atmospheric Chemistry Seminar Series, Narragansett, RI, Feb. 2012. Invited talk.
22. **Friedman, CL**; Selin, NE. Persistent organic pollution: Global transport and implications for policy. MIT Leading Technology and Policy Independent Activities Period, Cambridge, MA, Jan. 2012. Invited talk.
21. **Friedman, CL**; Selin, NE. A global 3-D model to simulate long-range transport of PAHs: Effect of climate on transport to the Arctic (poster). American Geophysical Union Fall Meeting, San Francisco, CA, Dec. 2011.
20. **Friedman, CL**; Selin, NE. A global 3-D model to simulate long-range transport of PAHs: Application to Arctic contamination (platform). 32nd annual North American SETAC meeting, Boston, MA, Nov. 2011
19. **Friedman, CL**; Lohman, R. Contrasting PCDD/F and PBDE activities in biota, sediment, and the water column of Newark Bay, New Jersey (USA) (platform). 32nd annual North American SETAC meeting, Boston, MA, Nov. 2011.
18. **Friedman, CL**, Selin, NE. Modeling global atmospheric transport of PAHs with GEOS Chem (platform). 5th International GEOS-Chem meeting, Cambridge, MA, May 2011.
17. Lambert, MK; **Friedman, CL**; Sullivan, J; Lohmann, R. The role of black carbon on the sorption of polychlorinated dioxins (poster). Annual Fall American Chemical Society meeting, Boston, MA, Aug. 2010.
16. **Friedman, CL**; Lohmann, R. Using passive samplers to determine the fate and transport of dioxins and furans in Newark Bay, NJ, USA (poster). Gordon Research Conference, Environmental Sciences: Water, Holderness, NH, June 2010
15. **Friedman, CL**; Lohmann, R. Using passive samplers to determine the fate and transport of dioxins and furans in Newark Bay, NJ, USA (poster). 20th annual European SETAC meeting, Seville, Spain, May 2010
14. **Friedman, CL**; Lohmann, R. Polyethylene passive sampling to estimate bioavailability of sedimentary organic contaminants: a laboratory and field comparison (poster). 20th annual European SETAC meeting, Seville, Spain, May 2010
13. Burgess, RM; Lohmann, R; Luey, PJ; **Friedman, CL**; Schubauer-Berigan, JP. Comparing the accumulation of PCBs by passive samplers and mussels from the water column at a contaminated sediment site (poster). 20th annual European SETAC meeting, Seville, Spain, May 2010.
12. **Friedman, CL**; Lohmann, R. Using passive samplers to determine the fate and transport of dioxins and furans in Newark Bay, NJ (platform). 30th annual North America SETAC meeting, New Orleans, LA, Nov. 2009.
11. **Friedman, CL**; Lohmann, R; Burgess, RM; Perron, MM; Cantwell, MG. Resuspension of contaminated field sediments and effect on PCB partitioning (platform). 30th annual North America SETAC meeting, New Orleans, LA, Nov. 2009.
10. Lohmann, R; **Friedman, CL**; Burgess, RM. Predicting the bioaccumulation of sedimentary hydrophobic organic contaminants to benthic invertebrates using EqP and passive samplers (platform). 30th annual North America SETAC meeting, New Orleans, LA, Nov. 2009.

9. Lohmann, R; **Friedman, CL**; Lambert, MK. The availability of sedimentary dioxins in the upper Newark Bay (platform). 30th annual North America SETAC meeting, New Orleans, LA, Nov. 2009.
8. Lambert, MK; **Friedman, CL**; Lohmann, R. The role of black carbon on the sorption of polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans at the Diamond Alkali Superfund site, Newark Bay, NJ. 30th annual North America SETAC meeting, New Orleans, LA, Nov. 2009.
7. Burgess, RM; Zhang, Y; McKee, MP; Lohmann, R; Luey, PJ; **Friedman, CL**; Schubauer-Berigan, JP; Lefkowitz, L. Evaluating PCB bioavailability using passive samplers and mussels at a contaminated sediment site. Battelle Conference on Remediation of Contaminated Sediments, Jacksonville, FL, Feb. 2009.
6. **Friedman, CL**; Burgess, RM; Perron, MM; Ho, KT; Cantwell, MG; Ryba, SA; McKinney, RA; Lohmann, R. Comparing polychaete bioaccumulation and passive sampler uptake to assess the effects of sediment resuspension on PCB bioavailability (poster). 29th annual North America SETAC Meeting, Tampa, FL, Nov. 2008.
5. Burgess, RM; Zhang, Y; McKee, MP; Lohmann, R; Luey, PJ; **Friedman, CL**; Schubauer-Berigan, JP; Lefkowitz, L. Comparison of passive sampling devices for measuring dissolved PCBs in the water column of a marine Superfund site (poster). 29th annual North America SETAC Meeting, Tampa, FL, Nov. 2008.
4. Perron, MM; Burgess, RM; Ho, KT; Pelletier, MC; **Friedman, CL**; Cantwell, MG; Shine, JP. Development and evaluation of polyethylene reverse samplers for marine Phase II whole sediment Toxicity Identification Evaluations (TIEs) (poster). 29th annual North America SETAC Meeting, Tampa, FL, Nov. 2008.
3. **Friedman, CL**; Burgess, RM; Perron, MM; Ho, KT; Cantwell, MG; Ryba, SA; McKinney, RA; Lohmann, R. Comparing polychaete bioaccumulation and passive sampler uptake to assess the effects of sediment resuspension on contaminant bioavailability (poster). Gordon Research Conference, Environmental Sciences: Water, Holderness, NH, June 2008
2. Burgess, RM; **Friedman, CL**; Sturgeon, NB; Perron, MM; Cantwell, MG; Ryba, SA; Ho, KT; Rego, SA; Lohmann, R. Comparison of polyethylene and organism uptake of PCBs in a standard laboratory bioaccumulation study with Superfund site sediments (poster). 13th annual NAC SETAC Meeting, Bristol, RI, June 2007
1. **Friedman, CL**; Lemley, AT; Hay, AG. Degradation of chloroacetanilide herbicides by anodic Fenton treatment (poster). 228th ACS National Meeting, Philadelphia, PA, September 2004.

TEACHING EXPERIENCE

- Instructor, Introductory Organic Chemistry Laboratory for Non-Majors, Simmons College, Spring 2006.
- Guest lecturer, Environmental Organic Chemistry, Graduate School of Oceanography – University of Rhode Island, Fall 2009.
- Teaching Assistant, Analytical Chemistry, Trinity College, Spring 2001.

Students supervised: S Schubert (undergraduate, URI, 2006-2007); A Koss (undergraduate, MIT, 2010); A Longboat (undergraduate, MIT, 2011), E. Field (high school summer student, MIT, 2012).

SYNERGISTIC ACTIVITIES

- Member of Society of Environmental Toxicology and Chemistry (SETAC), American Geophysical Union (AGU), Association of Polar Early Career Scientist (APECS), Earth Science Women's Network (ESWN)
- Peer reviewer for *Environmental Science and Technology*, *Environmental Toxicology and Chemistry*, *Atmospheric Environment*, *Chemosphere*, *Archives of Environmental Contamination*, *Environmental Pollution*, *Atmospheric Chemistry and Physics*
- Coordinated student activities for annual SETAC meeting in Boston, MA (2011)
- Organized and hosted URI-GSO Marine and Atmospheric Chemistry weekly seminar series (2010)
- North Atlantic Chapter (NAC) SETAC Board of Directors (2008-2010)

OTHER

Workshops/short courses:

1. **Preparing for an Academic Career in the Geosciences**, hosted by On the Cutting Edge (NSF). UNLV, Las Vegas, NV (2009). See <http://serc.carleton.edu/NAGTWorkshops/careerprep/index.html>.
2. **Nanotechnology: Environmental Implications and Applications**, hosted by NAC-SETAC and New England Society of Risk Analysis. Leominster, MA (2009).
3. **Sediment Toxicity Testing: Methods to Achieve Strong Data Sets and Interpret Results**, hosted by NAC-SETAC. Bristol, RI (2009).

Research Cruise: ICEALOT (International Chemistry Experiment in the Arctic LOwer Troposphere). Woods Hole, MA, USA to Tromsø, Norway, March 19 2008 – April 12 2008. Measured air and water concentrations of persistent organic pollutants across the Atlantic and in the Arctic.