**Period Covered by this Progress Report:** February 15, 2004–August 15, 2005
**Date of Report:** September 13, 2005
**HRF Fellowship:** GF/01/04
**Title:** Biogeochemical cycling of methylmercury in New York/New Jersey Harbor estuary
**Fellow:** Chad R. Hammerschmidt
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**Fellowship Period:** August 15, 2004–August 15, 2005

## Objectives in brief:

Monomethylmercury (MMHg) is a toxic byproduct of mercury (Hg) pollution in many coastal regions, and is of concern in the anthropogenically impacted (current and past) NY/NJ Harbor estuarine system. The general goal of this research is to investigate the biogeochemical factors affecting the production, distribution, and mobilization of MMHg from sediments in NY/NJ Harbor estuary.

## Progress Summary:

The sampling and analysis program is complete. Five research cruises on the R/V *Connecticut* were conducted in NY/NJ Harbor (August 2002; February, May, and August 2003; February 2004). The regions sampled include the Upper and Lower Harbors (including Raritan Bay) and Newark and Jamaica Bays (Figure 1).

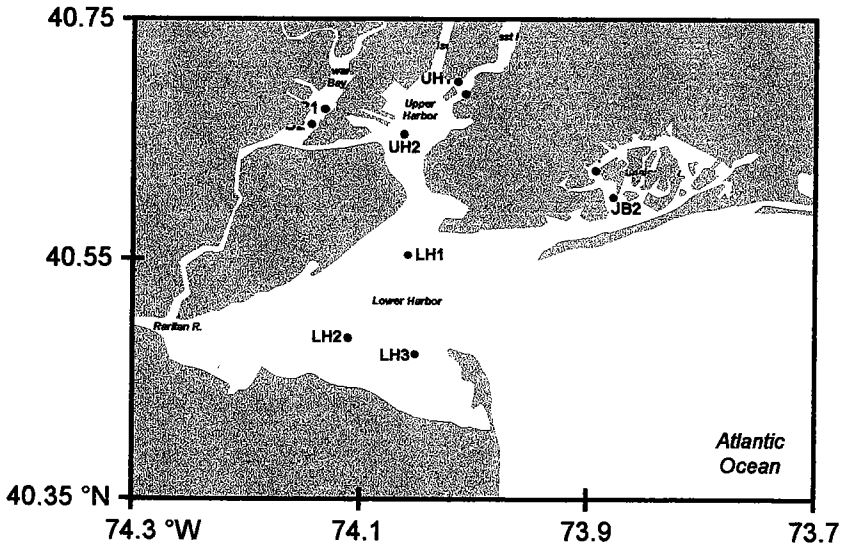


Figure 1. Location of sediment sampling locations in New York/New Jersey Harbor estuary.

***Surface Sediment Studies***

Analyses of Hg species in sediment and pore water, as well as ancillary measures of sediment geochemistry, biology, and Hg methylation have been completed. For each of the sampling sites and periods (August 2002; February, May, and August 2003; February 2004), these include the following analyses: porosity, grain size, total Hg and MMHg in sediment and pore water, pH, free dissolved sulfide, dissolved oxygen, acid-volatile sulfide, bacterial activity (aminopeptidase and glucosidase enzymes), bulk organic content of sediments, potential rates of Hg methylation (using an added stable isotope, $^{200}Hg^{2+}$), and enumeration and identification of benthic infauna.

Results from this research are still preliminary, but summarized in Chapter 6 of Hammerschmidt (2005), which is enclosed. It appears that the mechanisms affecting the distribution and production of MMHg in NY/NJ Harbor sediments are comparable to those we have observed in Long Island Sound (Hammerschmidt and Fitzgerald, 2004) and the continental shelf of southern New England (Hammerschmidt and Fitzgerald, submitted). That is, organic matter strongly affects the distribution and sediment–water partitioning of inorganic Hg in sediments, and this in turn affects the availability of inorganic Hg for methylation. The results from this portion of the study are currently being synthesized and summarized for publication in peer-reviewed scientific journal.

***Flux Chamber Studies***

I have designed and implemented a novel technique for assessment of MMHg mobilization from sediments in the Harbor. Shipboard flux chambers (SFC) allow for sediment to be collected with a box corer and incubated under in situ conditions on deck (Hammerschmidt, 2004). SFCs were employed in August 2003 and February 2004 to assess the flux of dissolved MMHg from Harbor sediments. Aliquots of water were removed from the chambers at regular intervals, filtered, and stored frozen until MMHg analysis. All SFC water samples have been analyzed, and results are currently being synthesized and compared to diffusive fluxes estimated from pore water measurements. It is expected that these experiments will provide valuable information regarding the diffusive and bioadvective flux of MMHg from Harbor sediments.

**References:**

Hammerschmidt, C. R. 2004. Biogeochemical cycling of methylmercury in New York/New Jersey Harbor estuary. Fellowship proposal submitted to the Hudson River Foundation, New York.

Hammerschmidt, C. R. 2005. The biogeochemical cycling of methylmercury in coastal marine sediments. Ph.D. dissertation, University of Connecticut.

Hammerschmidt, C. R., Fitzgerald, W. F. 2004. Geochemical controls on the production and distribution of methylmercury in near-shore marine sediments. *Environ. Sci. Technol.* 38, 1487–1495.

Hammerschmidt, C. R., Fitzgerald, W. F. Submitted. Methylmercury cycling in sediments on the continental shelf of southern New England. *Geochim. Cosmochim. Acta*

**Presentations:**

Hammerschmidt, C. R. (2005) The biogeochemistry of methylmercury in coastal marine sediments. *Dissertations Symposium on Chemical Oceanography (DISCO) XIX.* Waikoloa, HI, May 1-7.

Hammerschmidt, C. R. (2005) Biogeochemistry of methylmercury in the coastal zone. *Department of Geological Sciences, University of Michigan.* Ann Arbor, MI, March 11.

Hammerschmidt, C. R. 2005. Pursuits of methylmercury in the coastal zone. *Presentation to the Harvard School of Public Health.* Boston, MA, February 10.

Hammerschmidt, C. R., W. F. Fitzgerald, C. H. Lamborg, P. H. Balcom, P. T. Visscher, L. G. Graham. 2004. Biogeochemical controls on the production and distribution of methylmercury in sediments of Long Island Sound, New York/New Jersey Harbor, and the adjacent continental margin *7th International Conference on Mercury as a Global Pollutant.* Ljubljana, Slovenia, June 27–July 2.

Hammerschmidt, C. R. 2004. Mercury cycling and contamination in the coastal zone. *3rd Annual Northeast Regional Mercury Science Policy Workshop.* Kennebunkport, ME, May 27–28.

**Related Publications/Presentations:**

Hammerschmidt, C. R., W. F. Fitzgerald, C. H. Lamborg, P. H. Balcom, C.-M. Tseng. Submitted. Biogeochemical cycling of methylmercury in lakes and tundra watersheds of arctic Alaska. *Environmental Science & Technology*

Hammerschmidt, C. R., W. F. Fitzgerald. Submitted. Photodecomposition of methylmercury in an arctic Alaskan lake. *Environmental Science & Technology*

Hammerschmidt, C. R., W. F. Fitzgerald. Submitted. Methylmercury cycling in sediments of the continental shelf of southern New England. *Geochimica et Cosmochimica Acta*

Hammerschmidt, C. R., M. B. Sandheinrich. 2005 Maternal diet during oogenesis is the major source of methylmercury in fish embryos. *Environmental Science & Technology* 39, 3580-3584.

Hammerschmidt, C. R., W. F. Fitzgerald. 2005. Methylmercury in mosquitoes related to atmospheric mercury deposition and contamination. *Environmental Science & Technology* 39, 3034-3039.

Tseng, C.-M., C. R. Hammerschmidt, W. F. Fitzgerald. 2004. Determination of methylmercury in environmental matrixes by on-line flow injection and atomic fluorescence spectrometry. *Analytical Chemistry* 76, 7131–7136.

Balcom, P. H., W. F. Fitzgerald, G. M. Vandal, C. H. Lamborg, C. S. Langer, K. R. Rolfhus, C. R. Hammerschmidt. 2004. Mercury sources and cycling in the Connecticut River and Long Island Sound. *Marine Chemistry* 90, 53–74.

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Hammerschmidt, C. R., W. F. Fitzgerald. 2004. Bioaccumulation of methylmercury in Long Island Sound. *Long Island Sound Research Conference.* State University of New York-Stony Brook, NY, November 4–5.

Hammerschmidt, C. R., W. F. Fitzgerald. 2004. Mercury cycling and contamination in Long Island Sound. *Presentation to the Connecticut Department of Environmental Protection.* Hartford, CT, July 27.

Hammerschmidt, C. R., W. F. Fitzgerald. 2004. Abiotic mercury methylation in pore waters of coastal marine sediments. *7th International Conference on Mercury as a Global Pollutant.* Ljubljana, Slovenia, June 27–July 2.