Today’s date: May 1, 2009

Project number: R/CE-139

Project title: Mercury dynamics in estuarine sediments: biogeochemical controls on bioavailability and bioaccumulation along a chemical gradient

Project initiation date: 6/1/08

Principal investigator: Celia Y. Chen

Affiliation: Dartmouth College

Associate investigator(s) and affiliation(s):
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Brief project overview/Abstract:
We are interested in mechanistically assessing the role of estuarine sediments as long-term sinks or sources of Hg and MeHg, and investigating the link between MeHg production and mobilization in sediments to its bioavailability and bioaccumulation by resident benthic communities. We performed a) pore-water and sediment Hg, MeHg and ancillary chemistry analyses, b) analysis of abundance and diversity of targeted microbial communities and mer genes using molecular techniques, and c) analysis of the Hg and MeHg in benthic primary consumers and benthic omnivores.

Objectives:
a) To understand the biogeochemical controls on Hg and MeHg transformation in and mobilization from the sediment pore waters with respect to changes in organic matter concentration and the benthic infaunal density.

b) To link MeHg production and mobilization in sediments to the bioavailability and bioaccumulation of Hg and MeHg by resident intertidal benthic communities.

Research findings/accomplishments/progress to date:
We conducted a complete field sampling campaign in August 2008 at four sites in Great Bay estuary. These sites included Portsmouth mudflats, Squamscott mudflats, Chapman Spartina salt marsh and a salt panne in the same salt marsh. At each site, we performed the following measurements: pore-water concentrations of inorganic Hg, MeHg, hydrogen sulfide, iron, DOC, alkalinity and pH; sediment concentrations of inorganic Hg, MeHg, acid-volatile sulfide, organic carbon content, and porosity; sediment microbial analysis, including concentrations of sulfate reducers, iron reducers (geobacter), methanogens, and the mer-A gene; inorganic Hg and MeHg concentrations in fish (Fundulus), green crab and polychaetes.

Results show the same level of total Hg contamination at both mudflats, but considerably lower concentrations of pore-water inorganic Hg in Portsmouth mudflat than in Squamscott mudflat. This, together with significantly lower AVS, methanogen and mer-A
concentrations in Portsmouth mudflat than in Squamscott mudflat has prompted us to consider the potential role of bioturbation at the former site. Squamscott mudflat had significantly higher sediment MeHg concentrations than Portsmouth mudflat. Pore-water MeHg was also higher in the former site close to the sediment-water interface. As we had previously hypothesized, the MeHg concentration was highest at the sediment-water interface in the salt panne possibly due to the presence of ponded water.

The MeHg biota:sediment concentration factor (BSCF) in Fundulus was higher in Portsmouth mudflat (118) compared to that in Squamscott mudflat (37). The same trend was also observed for the crab and the polychaete at both sites. This is largely due to lower sediment MeHg concentrations at Portsmouth mudflat. Recent studies have shown a greater MeHg flux, but not necessarily higher MeHg production, at sites that are more subject to bioturbation. Our planned summer 2009 sampling campaign (May, July and September) will be considering the potential role of bioturbation on MeHg production and bioaccumulation at the two mudflats.

**Impacts to date:**
Our results from August 2008 have allowed us to hypothesize that bioturbation may have an important role in MeHg dynamics and bioaccumulation by higher organisms. We will be testing this hypothesis by collecting and analyzing chemical, microbial and biological samples in May, July and September of 2009.

**Problems encountered:**
We have not encountered any major problems. However, due to the highly dynamic nature of the Spartina salt marsh and its possible influence on Hg cycling, we have decided not to pursue sampling at this site.

**Publications to date** (please attach PDF if applicable):
None.

**Presentations to date, with published abstract citation if applicable:**


Students associated with project (for graduate students, please provide full name, thesis title and degree being pursued; for undergraduates, please provide full name and major):