SITE BIOGEOCHEMICAL PROCESSES AND MICROCOSM STUDIES (Hg SFA at ORNL)
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Scott C. Brooks* (brookssc@ornl.gov), Carrie Miller (millercl@ornl.gov), Craig Brandt (brandtcc@ornl.gov), Mary Anna Bogle (boglema@ornl.gov) , David Kocman (kocmand@ornl.gov), Xiangping Yin (yinx@ornl.gov), Yun Qian (qiany@ornl.gov), Rich Landis (Richard.C.Landis@USA.dupont.com), Jim Dyer (James.A.Dyer@usa.dupont.com)

**Oak Ridge National Laboratory*
P.O. Box 2008
MS 6038
Oak Ridge, TN 37831-6038
(865) 574-6398

Site investigation and geochemical modeling provide key information on major chemical species and processes involved in mercury (Hg) biogeochemical transformations in water and sediment along a longitudinal transect of lower East Fork Poplar Creek (EFPC) in Oak Ridge, TN.

In the past year three sites were established for long-term detailed characterization of the site biogeochemistry in surface water, interstitial pore water, and creek sediments. Similar measurements are being conducted on the adjacent floodplain sediments. Two of the sites are on the Hg-contaminated EFPC and one is located on a nearby reference stream that receives only atmospheric Hg fallout. Additionally, longitudinal surveys are conducted along EFPC at multiple locations at the same quarterly sampling interval. At all sites, early results show essentially uniform water quality parameters with depth into the creek sediment in the center of the creek channel whereas steep redox gradients are established in the fine grained deposits along the creek margin. Consistent with these observations dissolved methymercury (MeHgD; passes a 0.2 µm size pore) concentration increases with depth at the creek margin. There is no correlation between inorganic Hg and MeHg but the distribution of total Hg and total MeHg is correlated to sediment texture where higher concentrations are associated with finer texture. Although this may give the impression that the creek margins are the primary source of MeHg to the surface water of EFPC two other observations make this interpretation uncertain: (i) areas in the sediment with MeHg porewater concentration greater than the surface water do not appear to be hydraulically connected to the surface water, and (ii) in a benthic flux chamber study positive MeHg flux into the surface water was measured in the center channel but not at the creek margin. Further investigations are currently underway including measurements of Hg methylation and MeHg demethylation rates using intact cores of creek and floodplain sediments.

Both the quantity and quality of dissolved organic matter (DOM) change with increasing downstream distance in EFPC – the DOM concentration increases and transitions to higher molecular weight material with greater aromaticity. These changes are at least partially related to downstream changes in land cover in the watershed which transitions from heavily developed industrial and urban at the headwaters to mixed evergreen and deciduous forest near the mouth of the creek. Dissolved (passes 0.2 µm size pore) inorganic Hg is not related to DOM quantity or quality but MeHgD is positively correlated with DOM aromaticity and molecular weight. Additional studies are being conducted using ultrafiltration to further examine the relationship between DOM and Hg dynamics in this system.

Due to the volume of data generated, a data management system was adopted for archival and retrieval purposes. The system helps to achieve consistent reporting of field and laboratory results, including metadata, and facilitates organization and retrieval of results for analysis.