Comparison of Two Mercury Contaminated Surface Water Bodies

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As part of the Science Focus Area (SFA) project at ORNL, Task 1 will use complementary field observations and laboratory microcosm experiments to delineate key biogeochemical parameters influencing chemical and microbiological Hg transformations in Upper East Fork Poplar Creek (UEFPC), TN. During the initial seven months of the SFA project, task activities have focused on characterization of mercury (Hg) sources to the creek and general field sampling to gather chemical, physical, and microbial (in collaboration with Task 3 led by Palumbo) data. Additionally, we established a collaborative relationship with members of the South River Science Team which was formed to develop a better understanding of Hg behavior in the South River, VA. This poster compares and contrasts the hydrogeochemical characteristics of two industrially contaminated water bodies. Due to the methyl mercury (MeHg) burden in fish tissues, the Virginia Department of Health and the Tennessee Department of Environment and Conservation have posted fish advisories for the South River, VA and the East Fork Poplar Creek, TN (EFPC), respectively. Both streams share broad similarities in terms of their general chemistry and underlying geology. Nevertheless, patterns of waterborne Hg and, importantly, methyl mercury concentration are different. For example, in the South River both Hg and MeHg concentrations increase with increasing distance downstream from the industrial site of mercury origin whereas in EFPC Hg decreases while MeHg increases with increasing distance downstream. During the first five years of monitoring EFPC (1985-1989), Hg in fish tissue decreased with distance downstream (i.e., with dilution of the headwater inputs) suggesting that Hg bioaccumulation would decrease in response to headwater source reduction and removal. A number of actions decreased Hg contributions to the creek headwaters. Nevertheless, the subsequent fifteen years witnessed the emergence of a flat profile of Hg in fish with distance downstream resulting from a drop in Hg in fish at upstream locations and an increase in Hg in fish at downstream locations. Comparison to similar data from the South River suggests that the situation in EFPC represents a return to a typical condition rather than a deviation. Despite their similarities, the relationship between MeHg and Hg in these two systems is dramatically different. Although both sites are the focus of concerted research efforts to identify effective remediation, the underlying mechanisms that drive the patterns within each system and therefore account for the differences between them are poorly understood. We intend for this presentation to provide a context within which attendees can frame their discussion of the challenges inherent to studying the biogeochemical cycling of Hg in general and at contaminated sites in particular where effective remedies can be elusive.

This task will continue field sampling and characterization efforts to understand key parameters governing net MeHg production (methylation versus demethylation) in UEFPC and explore those parameters via controlled laboratory experimentation. Close integration with the other three SFA tasks is critical achieving the program goals.