Update on SR Working Hypotheses

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South River Expert Panel Meeting

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Working Hypotheses

A. External Sources of mercury to the river
B. Internal Sources of mercury to the river
C. Methyl mercury in the river system
D. Mercury loading and transport
E. Distribution of mercury in the floodplain

Working Hypotheses:

A. External Sources of Total Mercury to the River

- A1: The largest inventory of mercury in the system is in the 5 year flood plain
- A6: The floodplain from RRM 0 to 12 contains more mercury mass than the floodplain from RRM 12 to 25
- A3: Based on testing to date, floodplain soils have a higher fraction of exchangeable Hg than sediments
- A2: THg is introduced to the river from floodplain soils through eroding banks
- A8: Other potential external sources are dissolved mercury through wetting / drying cycles on the floodplain/ banks, alluvial groundwater, floodplain drainage features, atmospheric deposition

Working Hypotheses:
B. Internal Sources of Total Mercury to the River

- B1: Fine-grained deposits primarily located in the first 12 miles of the river contain sorbed mercury to which the aquatic environment is continuously or intermittently exposed.

- B3: Fine-grained deposits include deposits in long pools, FGCM deposits, remnant mill dam deposits, point bar-associated deposits, and bench deposits

- B7: In-stream gravel bars/beds have mercury sorbed to the (entrained) fine-grained sediments. The mercury is released through partitioning to pore water and bed turnover or hyporrheic flow.

Working Hypotheses:

C. Methyl Mercury in the South River

- C1: Dissolved mercury is more chemically reactive than sorbed Hg and the bioavailable pool of Hg is a fraction of the total dissolved Hg.

- C2: Mercury methylation is not limited by inorganic mercury as a substrate *OR* current MeHg production rates are at a maximum

- C3: MeHg production rates are highest in spring and early summer and decline over the height of the summer. This is due to temperature increase and at least one other factor such as a larger pool of bioavailable mercury.

- C6: MeHg production is optimal in the areas where DO is low, organic matter is abundant, electron acceptors are present, and temperature is sufficiently elevated.

- C7/8: Sites within the South River that may be conducive to MeHg production are patchy, small scale areas, just below the sediment water interface, within periphyton biomass, or within biofilms.

Working Hypotheses:

C. Methyl Mercury in the South River *continued*

- C12: The half-life of MeHg in water is short (~2 days) but may be much longer in sediments.
- C9: Bacterial consortia – such as Fe and S reducers are responsible for the methylation process.
- C14: MeHg may be introduced to the main stem of the river following rain events from floodplain drainages and other backwaters/ancillary channels
- OBSERVATION: Methylation is ubiquitous in SR but significant @ RRM~2 - 4.2 and RRM~7 - 9

Working Hypotheses:
D. Mercury Loading and Transport

- D1: Particulate Hg transport is important when considering long-term effects on the watershed but dissolved mercury is relatively more bioavailable in the short term.

- D2: In the SR when bank full conditions exist (1000 to 2000 cfs) unfiltered mercury increases in the water column as a result of contact with bank soils and remobilization of the particles.

- D3: During storm events a dilution effect is seen on the concentration of Hg on TSS due to an influx of fine ”clean” particles

- D4: During a storm event the amount of solids entering the system is equal to the amount exiting but solids exchange does occur.

- D6: During normal flow conditions mercury loading is highest in the upstream portion of the river.

Working Hypotheses:

E. Distribution of Mercury in the Floodplain

- E2: Distribution of Hg in the floodplain is determined by geomorphic setting and distance from the plant site.

- E3: In places river bank soils are enriched in Hg within a discrete zone approximately 1 to 2 ft. below the top of the bank. This interval may represent a period of time of peak Hg release (ca. 1945) or may be a natural result of soil horizon development.

- E4: In general, Hg concentrations in soil decrease with distance from the river and become shallower in the section.

- E5: Tributary banks / floodplains display a similar pattern of Hg distribution as the main stem.

- E6: Historic floodplain accretions (1937 to 1957) represent Hg storage areas that are higher in mass than other floodplain features with little or no accretion.