Application of synchrotron-based spectroscopic techniques and laboratory transport studies to understand cycling of mercury in a riverine environment

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Frequent changes in hydrogeological and geochemical conditions during flooding and precipitation events can lead to pronounced changes in Hg cycling in riverine settings. The study evaluated the mechanisms controlling the release and attenuation of Hg in river sediments and floodplain soils collected downstream of a former textile manufacturing plant in the South River, VA watershed. Synchrotron-based measurements, including X-ray absorption spectroscopy (XAS), high-energy resolution fluoresence detection XAS (HERFD-XAS) and micro X-ray fluoresence (μ-XRF), suggest Hg is present in the sediment in isolated locations as metacinnabar (β-HgS) and Hg bound to soil organic matter. Results of laboratory experiments conducted under fully-saturated flowing, fully-saturated stagnant, variably-saturated flooding and drainage, suggest release of Hg from different sediments along the river is more directly related to forms of Hg present in sediments. Variations in soil moisture content and redox conditions, affecting soil organic degradation processes and S cycling, also control the mobility of Hg in the sediments. This study provides important information on Hg cycling in a riverine environemnt for guiding future *in situ* remediation acitivities and assesssing environmental risks.