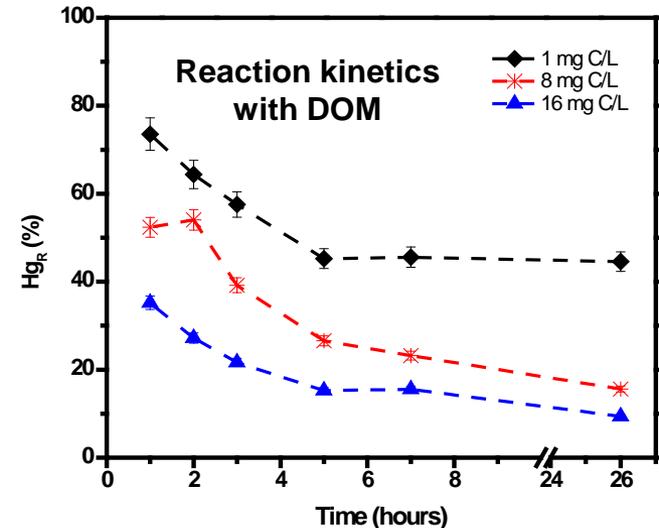
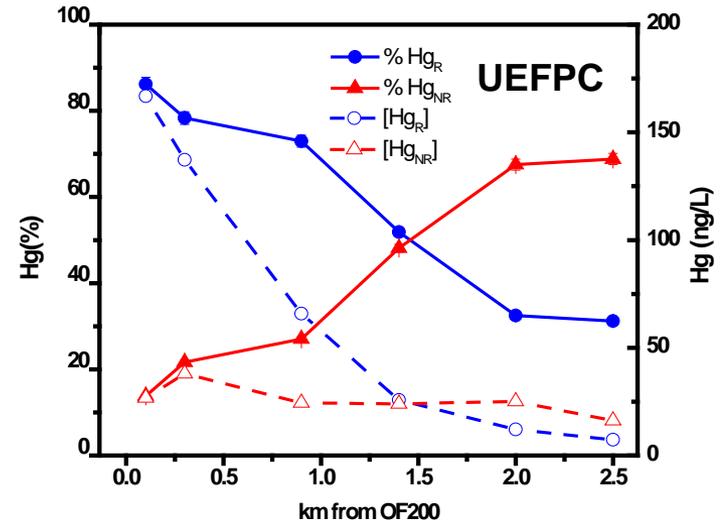


Kinetic controls on mercury complexation with dissolved organic matter - implications on reactivity

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DOE/Office of Science/Biological & Environmental Research

- Mercury (Hg) complexation with natural dissolved organic matter (DOM) is critical in controlling the transformation, the fate and transport of Hg in the environment
- This work found that Hg reactivity, measured by reducible fraction (labeled as Hg_R), in Upper East Fork Poplar Creek is controlled by the formation rate of strong Hg-DOM complexes
- The slow formation of nonreducible Hg_{NR} is likely a result of intricate interactions of Hg with multiple functional groups on the DOM before equilibrium is established
- For the first time, this research shows that kinetics could be one of the important factors controlling Hg reactivity and potentially its biological transformation



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It is well established that mercury (Hg) forms strong complexes with naturally occurring dissolved organic matter (DOM) in aquatic systems. These complexes likely influence the microbial production of methylmercury, the form of mercury that is a human neurotoxin and bioaccumulates in aquatic organisms.

In most studies examining the interaction of Hg with DOM, it is assumed that complexation equilibrium has established, thus inexplicitly implied that kinetics, or the rate of formation, is not important. Scientists from Oak Ridge National Laboratory demonstrate that equilibrium assumption is not true in systems that receive a constant source of inorganic mercury, such as in the Upper East Fork Poplar Creek (UEFPC), which originates in the Y-12 National Security complex in Oak Ridge, Tennessee.

Using reducible Hg_R as a means to monitor the formation of the strong Hg-DOM complexes, scientists found that several hours are required to establish the equilibrium. The headwater of UEFPC (shown as OF200 in Figure), containing a high concentration of inorganic Hg (~ 1000 ng/L), is mixed with water from Melton Hill Lake with ~ 3 mg/L DOM to form the creek at the site. Due to the slow rates of Hg-DOM formation, complexation equilibrium is not established in the upper 2.5 km of this system. Greater than 25% of the Hg was present as reducible Hg complexes 2.5-km downstream from the headwater. As Hg complexation is important for Hg reactivity in aquatic systems, the kinetics demonstrated in this study, will be critical in future studies examining the production of methylmercury and cycling of inorganic mercury in UEFPC and other Hg contaminated systems.

Miller, C.; Southworth, G.; Brooks, S. C.; Liang, L.; Gu, B. (2009) Kinetic controls on the complexation between mercury and dissolved organic matter in a contaminated environment. *Environ. Sci. Technol.* 43, (in press).