

Complexation and reactivity of mercury with natural organic matter (NOM) and particles in East Fork Poplar Creek in Oak Ridge, Tennessee, USA

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Kinetic controls on the complexation and reactivity of inorganic mercury (Hg) is often overlooked but may greatly influence the aquatic transformation and cycling of Hg. Using reducible Hg measurements on creek water and solutions containing dissolved natural organic matter (NOM) isolates, we found that the formation rate of Hg-NOM complexes ($k = 0.05 - 0.29 \text{ hr}^{-1}$) are on time scales that are likely important in affecting the reactivity of Hg in the EFPC aquatic ecosystem. Competitive ligand titrations showed that the strength and reactivity of Hg-NOM complexes increases with increasing equilibration time between the Hg and NOM. This likely is a result of the transfer of Hg from weaker to strong binding sites within the macromolecular NOM structure. In the upper 2.5 km of EFPC, kinetic controls on Hg complexation is evident by the presence of reducible Hg at concentrations higher than expected if the complexation between Hg and NOM is instantaneous and equilibrium was established in the system. The interaction of Hg with particles is also kinetically controlled in EFPC with particulate bound Hg increasing downstream. Understanding the association of Hg with NOM and particles in EFPC is a critical step in elucidating the controls on Hg methylation and Hg redox cycling in this system.