Elucidating the Role of Low-Molecular-Weight Natural Organics in Hg Photoredox Transformation

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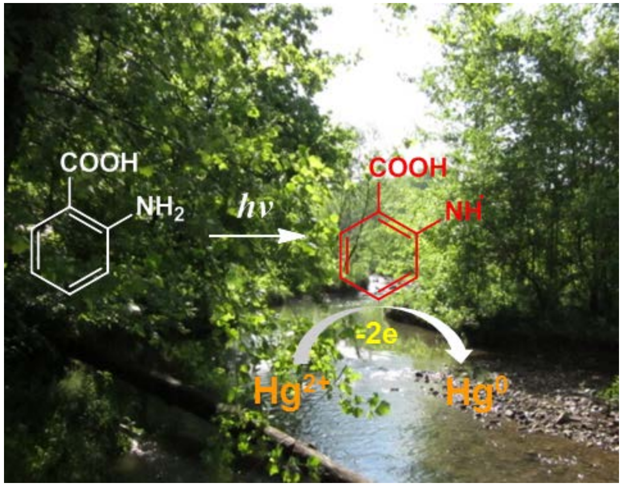
DOE/Office of Science/Biological & Environmental Research



Objective

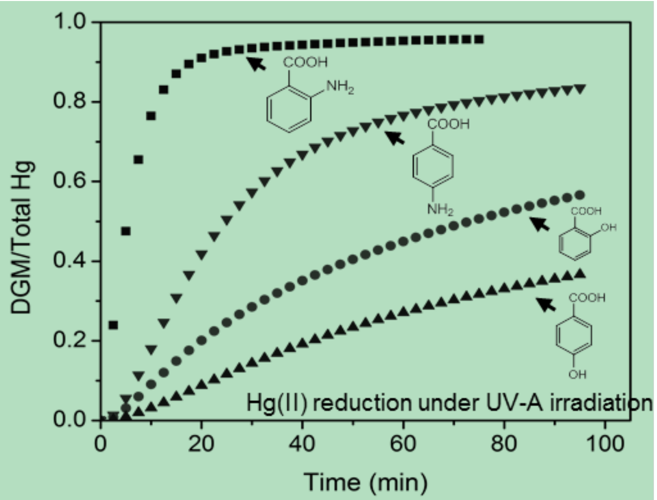
- Understand the role of low-molecular-weight natural organics as surrogates of natural organic matter in Hg photo-redox transformation.

New Science

- Photoreduction rates of Hg(II) by benzoic acid derivatives are influenced not only by the substituent functional groups such as –OH, $–NH_2$ and –COOH on the benzene ring, but also the positioning of these functional groups on the ring structure.
- The rates correlate strongly with ultraviolet (UV) absorption of these compounds and their concentrations.

Significance

- The formation of organic free radicals during photolysis of organics is likely responsible for Hg(II) reduction, affecting Hg speciation and cycling in natural waters.



He, F., W. Zheng, L. Liang and B. Gu. 2012. Mercury photolytic transformation affected by low-molecular-weight natural organics in water. Sci. Tot. Environ. 416:429-435 (doi:10.1016/j.scitotenv.2011.11.081).

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Mechanisms by which dissolved organic matter (DOM) mediates the photochemical reduction of Hg(II) in aquatic ecosystems are not fully understood, owing to the heterogeneous nature and complex structural properties of DOM. Using naturally occurring aromatic compounds, including salicylic, 4-hydrobenzoic, anthranilic, 4-aminobenzoic, and phthalic acid, as surrogates for DOM, we demonstrate that the photoreduction rates of Hg(II) are influenced not only by the substituent functional groups such as –OH, $–NH_2$ and –COOH on the benzene ring, but also the positioning of these functional groups on the ring structure. The Hg(II) photoreduction rate decreases in the order anthranilic acid > salicylic acid > phthalic acid according to the presence of the $–NH_2$, –OH, –COOH functional groups on benzoic acid. The substitution position of the functional groups affects reduction rates in the order anthranilic acid > 4-aminobenzoic acid and salicylic acid > 4-hydroxybenzoic acid. Reduction rates correlate strongly with ultraviolet (UV) absorption of these compounds and their concentrations, suggesting that the formation of organic free radicals during photolysis of these compounds is responsible for Hg(II) photoreduction. These results provide insight into the role of low-molecular-weight organics and possibly DOM in Hg photoredox transformation.

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