Binding Constants of Mercury and Dissolved Organic Matter Determined by a Modified Ion Exchange Method

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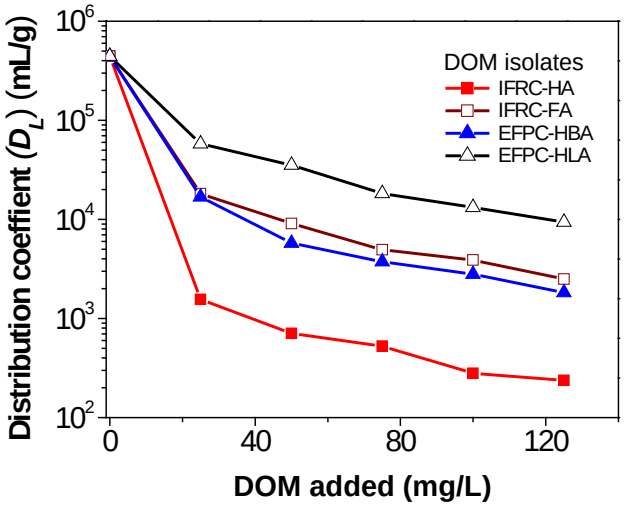
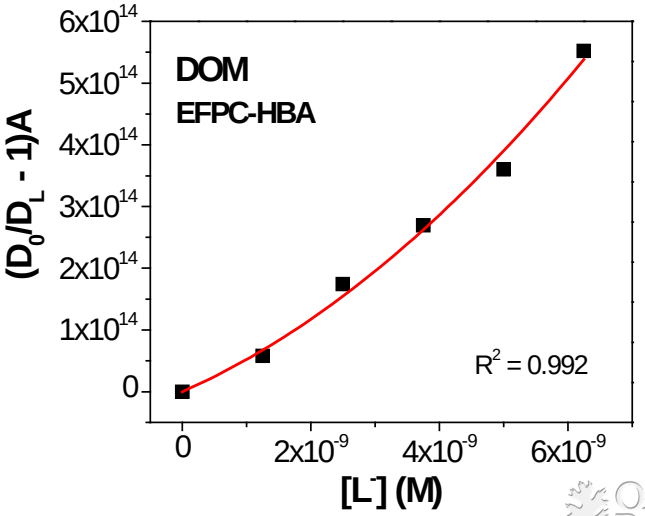
DOE/Office of Science/Biological & Environmental Research

- Dissolved organic matter (DOM) forms exceptionally strong complexes with mercury (Hg), thus influencing Hg speciation, transformation, and bioavailability in aquatic ecosystems.
- To date, no reliable technique is available to determine Hg-DOM binding strengths and no agreeable binding constants exist.
- We developed a new, modified ion-exchange technique that not only determines binding constants between Hg and DOM, but also distinguishes complexes of Hg with varying ligand coordination numbers, i.e., 1:1 or 1:2 Hg:thiol-ligand (HgL) complexes.
- Results suggest that at a relatively low ratio of Hg to DOM, Hg binds DOM via key thiolate groups in different kinds of DOM.





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Ion-exchange techniques have been widely used for determining the conditional stability constants (logK) between dissolved organic matter (DOM) and various metal ions in aqueous solution. An exception is mercuric ion, Hg^{2+}, whose exceedingly strong binding with reduced sulfur or thiol-like functional groups in DOM makes the ion exchange reactions difficult. Using a Hg-selective thiol resin, we have developed a modified ion-exchange technique which overcomes this limitation. This technique allows not only the determination of binding constants between Hg^{2+} and DOM of varying origins, but also the discrimination of complexes with varying coordination numbers [i.e., 1:1 and 1:2 Hg:thiol-ligand (HgL) complexes]. Measured logK values of four selected DOM isolates varied slightly from 21.9 to 23.6 for 1:1 HgL complexes, and from 30.1 to 31.6 for 1:2 HgL_2 complexes. These results suggest similar binding modes exist between Hg^{2+} and key thiolate functional groups in DOM particularly at a relatively low Hg to DOM ratio. Future studies should further elucidate the nature and precise stoichiometries of binding between Hg^{2+} and DOM at environmentally relevant concentrations.

Dong, W., Y. Bian, L. Liang and B. Gu. 2011. Binding constants of mercury and dissolved organic matter determined by a modified ion exchange technique. Environ. Sci. Tech. 45:3576-3583 (doi:10.1021/es104207g).