

Characterization of Mercury Interactions with Individual Molecular Species in Natural Organic Matter

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Natural organic matter (NOM) is known to form stable complexes with mercury (Hg) as well as to participate in redox transformations that affect Hg speciation in the environment. These interactions determine the bioavailability of Hg and consequently, the rate at which it is taken in and converted to highly toxic methylmercury by methylating bacteria. NOM has frequently been treated as a singular substance or a few operationally defined fractions in studies of the speciation and sequestration of Hg. However, the fate of the exposed NOM, including the molecular transformations of the individual compounds therein, has rarely been characterized because NOM is one of the most complex and analytically challenging sample mixtures known. Nonetheless, these measurements are now possible with high-performance liquid chromatography and high-resolution mass spectrometry. In this study, we explore the interactions of NOM with both Hg(0) and Hg(II) by exposing them to NOM samples of both terrestrial and aquatic origins. Taking full advantage of the quantitative capabilities of these high throughput analytical approaches, we have employed multivariate statistics such as principal component analysis to describe the interrelated transformations of compounds in NOM following exposure to Hg. We discuss the identification of the key molecular species that participate in Hg complexation and redox reactions with important implications to the bioavailability and microbial methylation of Hg in the environment.