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Transport and Fate of Mercury in the Environment

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Assessing sulfate and carbon controls on net methylmercury production in peatlands: An in situ mesocosm approach

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Abstract

The transformation of atmospherically deposited inorganic Hg to the toxic, organic form methylmercury (MeHg) is of serious ecological concern because MeHg accumulates in aquatic biota, including fish. Research has shown that the Hg methylation reaction is dependent on the availability of SO_4 (as an electron acceptor) because SO_4-reducing bacteria (SRB) mediate the biotic methylation of Hg. Much less research has investigated the possible organic C limitations to Hg methylation (i.e. from the perspective of the electron donor). Although peatlands are long-term stores of organic C, the C derived from peatland vegetation is of questionable microbial lability. This research investigated how both SO_4 and organic C control net MeHg production using a controlled factorial addition design in 44 in situ peatland mesocosms. Two levels of SO_4 addition and energetic-equivalent additions (i.e. same number of electrons) of a number of organic C sources were used including glucose, acetate, lactate, coniferous litter leachate, and deciduous litter leachate. This study supports previous research demonstrating the stimulation of MeHg production from SO_4 input alone (~200 pg/L/day). None of the additions of organic C alone resulted in significant MeHg production. The combined addition of SO_4 and some organic C sources resulted in considerably more MeHg production (~500 pg/L/day) than did the addition of SO_4 alone, demonstrating that the highest levels of MeHg production can be expected only where fluxes of both SO_4 and organic C are delivered concurrently. When compared to a number of pore water samples taken from two nearby peatlands, MeHg concentrations resulting from the combined addition of SO_4 and organic C in this study were similar to MeHg "hot spots" found near the upland–peatland interface. The formation of MeHg "hot spots" at the upland–peatland interface may be dependent on concurrent inputs of SO_4 and organic C in runoff from the adjacent upland hillslopes.

Figures and tables from this article:

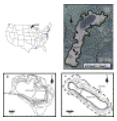

Fig. 1. The study area, located at the Marcell Experimental Forest (MEF) in north-central Minnesota. The principal study site was (a) Bog Lake Bog (aerial photograph; peatland outlined in dark black). Peatland pore waters were also sampled in two nearby peatlands: (b) S2 and (c) S6. "+" denote pore water sampling points.

Figure options