Distribution of inorganic and methylmercury in METAALICUS Lake 658 after addition of stable mercury isotopes

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Abstract: After applying stable isotopes of ^{202}Hg to Lake 658 of the Experimental Lakes Area, approximately 2 % of the added isotope was present as methylmercury in the water column. In 2001, the first year of the application, ^{202}HgT in surface water fluctuated between 1.5-2 ng/L. In 2002, it varied from 2-3 ng/L. After fall turnover, concentrations leveled out at 0.7 ng/L in 2001, increasing to 1.0 ng/L in 2003. Ambient HgT was typically 2.2 ± 0.8 ng/L everywhere in the lake. Me^{202}Hg peaked eventually at 25 pg/L (ambient MeHg: ~ 125 pg/L) in the epilimnion and reached in the hypolimnion levels of up to 300 pg/L (ambient MeHg: 1050 pg/L).

Key words: methylmercury, methylation, METAALICUS, lake water, stable mercury isotopes

INTRODUCTION

This presentation summarizes the dynamics of in-lake processes observed during the initial two years of the METAALICUS project. To evaluate the relationship between atmospheric loading and ensuing Hg concentrations in fish, the mercury load to Lake 658 at the Experimental Lakes Area (ELA) was increased by addition of a Hg solution enriched with ^{202}Hg(II).

MATERIALS AND METHODS

The isotope was delivered to the lake surface through biweekly additions of the isotopic Hg. Spikes were added nine times starting in early summer and commencing until mid-fall. The applications resulted in a uniform distribution of the isotope within 24 hours after spiking. During the experiment, water profiles were collected to follow the distribution of the isotope into the water column and to record the evolution of methylmercury formation from the added spike. Water samples were filtered in-line on quartz fibre filters using a teflon cartridge to obtain concentrations of dissolved and particulate Hg and MeHg. The Hg additions created a regular sawtooth pattern of ^{202}Hg levels in surface water as shown in Figure 1.

During the summer months, the majority of the added isotope was constrained to the epilimnion. Two weeks after spiking, the first

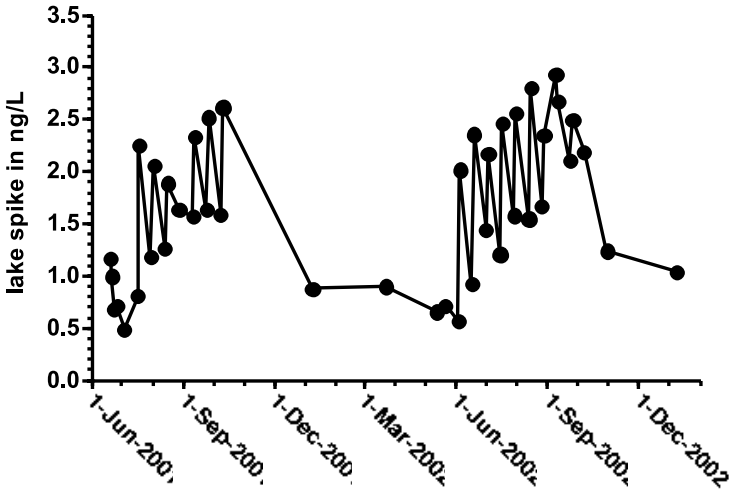

Figure 1. Evolution of lake Hg spike (Hg enriched with ^{202}Hg) concentration during the first two years of Hg additions to Lake 658. Mercury was added biweekly during the summer season.

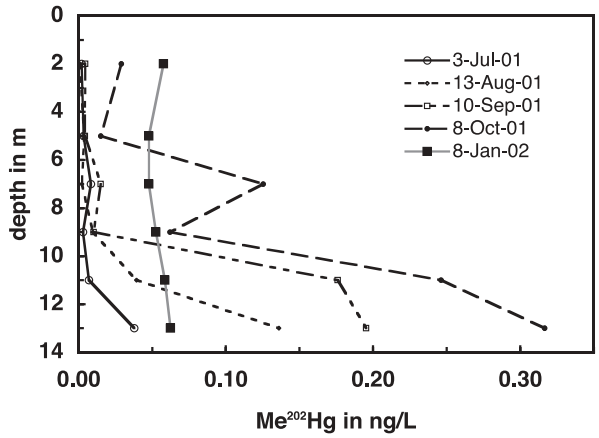

Figure 2. Evolution of $Me^{202}Hg$ water column profiles representing new $Me^{202}Hg$ from the added ^{202}Hg during the first year of Hg additions.

isotopic methylmercury was observed at the bottom of the lake near the sediment water interface. Isotopic and ambient MeHg accumulated in the anoxic zone of the hypolimnion in late summer. As illustrated in Figure 2, concentration profiles for HgT and MeHg were uniform throughout the water column after fall turnover, indicating complete mixing of epilimnetic HgT and hypolimnetic MeHg into the whole lake volume.

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