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The effect of lake browning and respiration mode on the burial and fate of carbon and mercury in the sediment of two boreal lakes

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Abstract:

In many northern temperate regions, the water color of lakes has increased over the past decades ("lake browning"), probably caused by an increased export of dissolved organic matter from soils. We investigated if the increase in water color in two lakes in Norway has resulted in increased burial of organic carbon (OC) and mercury (Hg) in the sediments and if the Hg was prone to methylation. Lake Solbergvann experienced a threefold water color increase, and OC burial increased approximately twofold concomitant to the water color increase. This lake had prolonged periods of anoxic bottom water and anoxic OC mineralization rates were only about half of the oxic OC mineralization rates (7.7 and 17.5 g C m^{-2} yr^{-1}, respectively), contributing to an efficient OC burial. In Lake Elvaga, where water color increase was only approximately twofold and bottom water was oxygenated, no recent increase in OC burial could be observed. Hg burial increased strongly in both lakes (threefold and 1.6-fold in Lake Solbergvann and Lake Elvaga, respectively), again concomitant to the recent water color increase. The proportion of methylated Hg (MeHg) in surficial sediment was 1 order of magnitude higher in Lake Elvaga (up to 6 % MeHg) than in Lake Solbergvann (0.2 – 0.6 % MgHg), probably related to the different oxygenation regimes. We conclude that lake browning can result in increased OC and Hg burial in lake sediments, but the extent of browning and the dominating mode of sediment respiration (aerobic or anaerobic) strongly affect burial and fate of OC and Hg in sediments.

Keywords: Organic carbon burial, mercury, anoxic bottom water, methylated Hg, oxygenation