Impact of the carbon cycle on mercury dynamics in a river impacted by run-of-the-river power plants, logging and forest fire

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Run-of-the-river hydroelectric power plants are thought to have little impact on Hg methylation and food web contamination, because they do not cause flooding of large areas. On the St. Maurice River (Canada), an unpredicted increase in Hg accumulation in top predators was observed after the construction of two such power plants, in the vicinity of a native community. This riverscape was also altered by a large forest fire and by logging activities. We studied this system to identify key drivers of Hg cycling with various approaches, including isotopic tracing for methylation/demethylation rates in sediments and periphyton, metagenomic analyses of genes related to Hg cycling and to metabolism of key methylating guilds, 13C and 15N tracing of food web transfer, and geochemical analyses including quality of DOM and Itrax XRF scanner.

We found that the small inpoundment upstream of the power plants were sites of Hg and MMHg accumulation in sediments. There was a strong association between organic matter content and Hg and MMHg concentrations. It is likely that these reservoirs are acting as sedimentation basins for fresh organic matter originating from logging activities, and the fresh organic carbon fuels methylation. Methylation genes (*hgcA*) were found at most sites and the number of copies was positively correlated to copies of genes linked to methanogenesis. Carbon sources (13C) modulated Hg accumulation at the base of the food chain whereas trophic levels (15N) explained variations up to the top of the food chain. This study indicates that carbon cycling is a key driver of Hg dynamics in this system.