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Permafrost thaw increases methylmercury formation in sub-arctic Fennoscandia

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With ongoing climate change, temperatures in the northern latitudes are increasing more than twice as fast as the global mean. This causes thawing of permafrost and the release of carbon and contaminants, including mercury (Hg), which have thus far been immobilized in the frozen soil. The potential release of Hg, and microbial transformation of mobilized inorganic Hg to monomethylmercury (MeHg), presents a risk to ecosystems and human health. MeHg is a neurotoxic substance that is readily taken up and biomagnified in aquatic food webs to dangerous concentrations. Arctic communities are particularly vulnerable to Hg pollution as a result of a diet that often includes high trophic level fish and marine mammals. Despite the ecological and societal consequences of elevated Hg levels and the potential for increased Hg conversion to MeHg in post-thaw wetland environments, much of the Hg cycle in the high North is poorly understood.

While global and northern latitude Hg budgets have been estimated, the effect of permafrost thaw on MeHg formation has not yet been fully investigated. Here, we compared concentrations of total Hg (HgT) and MeHg in intact permafrost samples from palsas and peat plateaus with samples from recently thawed collapse fens and from peatlands unaffected by permafrost dynamics in order to investigate whether permafrost thaw impacts net MeHg formation in peatlands. Our study includes five subarctic permafrost peatland sites located in northern Sweden and Norway. Concentrations of HgT and MeHg in the soil cores ranges from 1.1 to 210 and 0.005 to 28 ng g-1 dry weight, respectively, with higher concentrations in the upper soil horizons. No differences were observed in average HgT and MeHg concentrations between the five sites, including both coastal and inland locations. Interestingly, we observe higher concentrations of MeHg and MeHg:HgT ratios in the collapse fens as compared to the permafrost cores, showing increased net methylation of Hg upon permafrost thaw.