Mercury methylation and demethylation in paddy soil with and without rice plants

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Methylmercury (MeHg) is a neurotoxin that can accumulate in rice via uptake from the paddy soil into the plant. Mercury methylation and demethylation are microbial processes that control the concentration of MeHg ([MeHg]) in paddy soil, although their relative influence may differ between vegetated and non-vegetated soils. This study is the first to assess potential rates of methylation and demethylation (K_{meth} and K_{demeth}) simultaneously in a manner that explicitly compares how they affect [MeHg] in the vegetated and non-vegetated paddy soil compartments. Flooded rice paddy soil microcosms (2x10x20") with and without rice plants were amended with enriched Hg stable isotopes (^{200}Hg and $Me^{201}Hg$) to assess K_{meth} and K_{demeth}. Overall, the results of this study suggest that MeHg concentrations are differentially controlled by MeHg production and degradation processes, depending on whether plants are present. In non-vegetated soils, K_{meth} was positively correlated with both ambient [MeHg] ($p = 0.02$, $r = 0.90$) and the percent of total Hg present as MeHg (%MeHg; $p = 0.023$, $r = 0.87$), while K_{demeth} had no relationship ($p = 0.77–79$), indicating that MeHg formation drove MeHg dynamics. In planted soils, by contrast, K_{meth} did not correlate to [MeHg] ($p = 0.79$). Rather, K_{demeth} was negatively correlated with both [MeHg] ($p = 0.04$, $r = -0.82$) and %MeHg ($p = 0.036$, $r = -0.84$), suggesting that degradation of MeHg was a more important control on the [MeHg] of vegetated soils.