Does Agricultural Runoff Influence Anaerobic Methanotrophy in a Southern Californian Wetland?

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Wetlands are a rapidly growing source of atmospheric methane – a potent greenhouse gas – and are major natural contributors to the annual methane burden. Anthropogenic activity, including agriculture, may feed high concentrations of nitrate into wetlands. The impact of agricultural nitrate on anaerobic oxidation of methane – a significant sink for methane produced in wetland sediment – is not well understood. Likewise, the significance of the anaerobic oxidation of methane to alleviating the wetland nitrate burden is not yet well-studied. Nitrate is a thermodynamically favorable electron acceptor for anaerobic oxidation of methane. Consequently, high concentrations of nitrate may inhibit or minimize the use of other electron acceptors, such as iron and sulfate. The role of agricultural runoff for wetland anaerobic oxidation of methane may thus be pertinent to projecting future wetland methane emissions. We performed anoxic sediment slurry incubations to simulate agricultural runoff into a coastal wetland utilizing surface, runoff-exposed brackish sediment collected from a Southern Californian wetland — the Carpinteria Salt Marsh Reserve. We utilized ^{15}N-nitrate, ^{35}S-sulfate, and ^{14}C-methane labeling techniques to assess rates of nitrate reduction, sulfate reduction, and anaerobic oxidation of methane, respectively. We incubated slurry with and without methane, differentiating nitrate and sulfate reduction dependent on anaerobic oxidation of methane from all present nitrate and sulfate reduction. Preliminary ^{15}N-nitrate incubation results indicate that, in the presence of methane, denitrification and anammox rates significantly increase. DNRA rates were not significantly affected by the presence of methane. This may indicate that anaerobic methanotrophy is significant to removing nitrate from the brackish wetland sediment via denitrification and (potentially indirectly) anammox. Anaerobic methanotrophy did not significantly affect DNRA rates – a process that retains biological nitrogen within the system. Preliminary ^{35}S-sulfate incubation results indicate that high nitrate input may suppress sulfate reduction. Future analysis of ^{14}C-methane incubations will illuminate the significance of high nitrate input on anaerobic methane oxidation, particularly whether this partial sulfate reduction suppression is correlated with partial anaerobic methane oxidation suppression. Furthermore, analysis of ^{14}C-methane incubations will shed light on the individual significance of nitrate- and sulfate- dependent anaerobic oxidation of methane to total anaerobic oxidation of methane. This work will provide a deeper look into the dominant processes driving anaerobic methane removal in coastal wetland sediment and the potential role of agricultural runoff in shaping which processes dominate.