ACETATE AND C1 COMPOUNDS ARE LARGELY IGNORED BY METHANOGENS IN NORTHERN WETLANDS. M. E. Hines[1], K. N. Duddleston[1], R. B. Reich[1], and R. P. Kiene[2], [1]University of Alaska-Anchorage, Department of Biological Sciences, Anchorage AK 99508, USA (afmeh@uaa.alaska.edu), [2]University of South Alabama.

Introduction: Typical methanogenic decomposition pathways include near-terminal carbon intermediates that turn over rapidly with small pool sizes. The most important of these is acetate, which occupies a pivotal position between fermenting and acetogenic processes and methanogenesis. Other molecules that are utilized directly by methanogens, such as C1 compounds (e.g., methanol and dimethylsulfide (DMS)), behave similarly in that they are often present in small pools that cycle quickly. Some of these latter materials, such as methanol, can also be important intermediates in the anaerobic C cycle. Our investigations revealed that incubations of peat from oligotrophic wetlands like bogs display linear increases in DMS with no consumption [1]. Here we report that the accumulation of DMS is due to the lack of consumption by methanogens at low pH and low temperature. Further studies revealed that under these conditions other C1 compounds and acetate are also not utilized.

Experimental: Peat samples from a poor fen in New Hampshire and several wetlands in Alaska were used for incubation studies for examining the turnover of several compounds. Results were compared to those from sediment samples from lakes and creeks. Anaerobic slurry incubations were amended with various electron acceptors and inhibitors, and concentrations of CH_4, CO_2, DMS and acetate determined by GC or IC techniques. Turnover rates of acetate, methanol, trimethylamine, and methylmercury were determined using radiotracers. A seasonal study of pore water chemistry and microbial rates is being conducted in an Alaskan bog.

Results: *Sphagnum*-dominated wetlands did not consume acetate or any of the C1 compounds when the natural pH was below 4.6 or the temperature was below 15°C. In some instances, we were unable to detect any turnover using ^{14}C substrates with incubations of several hours to days. Higher pH wetlands in Alaska did not consume these compounds either. However, temperate minerotrophic fens and freshwater sediments readily consumed all compounds tested. Alaskan peats that were held at 22°C for several weeks began to consume the intermediates, albeit slowly. The lack of consumption of intermediates occurred only when methanogenesis was the terminal process. However, under these conditions methane production continued actively. Introduction of O_2 into slurries, in which acetate had previously accumulated anaerobically, resulted in a steady decrease in acetate levels. Acetate production appeared to be predominantly fermentative rather than autotrophic via acetogenesis, and rates of production were significant (up to 0.5 mmol L^{-1} d^{-1}). Pore water acetate concentrations reached 1.0 mM.

Discussion: It is generally considered that C1 compounds like DMS, and important intermediates like acetate, are rapidly cycled in anaerobic environments [2, 3]. However, in wetland soils typical of northern latitudes and in more southerly habitats that are oligotrophic, these compounds are not utilized methanogenically. This differs from the instance where acetate levels are high during the spring prior to the commencement of rapid acetoclastic methanogenesis [4]. In the wetlands we are studying, acetate can accumulate all season despite the occurrence of rapid methane production. It also appears to differ from situations where homoacetogenesis occurs in lieu of methanogenesis.

The lack of consumption of compounds, particularly acetate, greatly affects how we envisage terminal degradation processes in methanogenic northern wetlands. First, methanogenesis is restricted primarily to H_2 metabolism. Second, under methanogenic conditions, acetate production represents a terminal process and is a sink for a significant portion of metabolized C. The ultimate fate of this acetate is aerobic oxidation to CO_2 after diffusion into surficial peats. Hence, C destined for CH_4 is bypassed to CO_2 via O_2 respiration, and does not contribute to atmospheric CH_4. Global warming may reverse this trend by enhancing the methanogenic degradation of acetate.

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