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Methanogenesis and anaerobic acetate turnover in an acidic peat bog

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We investigated anaerobic acetate oxidation (AAcO), homoacetogenesis and methanogenesis in an acidic *Sphagnum* peat, following the turnover of ^{14}C-bicarbonate and [2-^{13}C]- or [2-^{14}C]-acetate, respectively. AAcO was detected in samples collected over five years. The lack of alternative electron acceptors suggested, that AAcO was based on the syntrophic oxidation of acetate to H_2 and CO_2. CH_3F, which specifically inhibits acetoclastic methanogenesis, did not affect AAcO, as predicted for a H_2-based syntrophy. Syntrophic acetate oxidation was largely coupled to methanogenesis. Correspondingly, the methanogenic community was dominated by hydrogenotrophic methanogens, and a high ratio of CH_4 originated from H_2/CO_2. Production of $^{14}CH_4$ and ^{14}C-acetate from ^{14}C-bicarbonate indicated both hydrogenotrophic methanogenesis and homoacetogenesis. Homoacetogenesis was strongly stimulated by H_2. Analysis of the formyltetrahydrofolate synthetase gene revealed a new deep branching group of acetogenic sequences. Since homoacetogens are known to be capable of syntrophic acetate oxidation via the acetyl-CoA-pathway, they may have been responsible for both homoacetogenesis and AAcO. Although samples came from the same spot, AAcO rates varied between different years. Inter-annual variation of precipitation and hence hydrology may have had an effect. Further results indicate that next to the acetyl-CoA-pathway a second pathway may contribute to AAcO, either involving fermenting or humin-reducing bacteria.