



Isotope fractionation during the anaerobic consumption of acetate by methanogenic and sulfate-reducing microorganisms

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During the anaerobic degradation of organic matter in anoxic sediments and soils acetate is the most important substrate for the final step in production of CO₂ and/or CH₄. Sulfate-reducing bacteria (SRB) and methane-producing archaea both compete for the available acetate. Knowledge about the fractionation of ¹³C/¹²C of acetate carbon by these microbial groups is still limited. Therefore, we determined carbon isotope fractionation in different cultures of acetate-utilizing SRB (*Desulfobacter postgatei*, *D. hydrogenophilus*, *Desulfobacca acetoxidans*) and methanogens (*Methanosarcina barkeri*, *M. acetivorans*). Including literature values (e.g., *Methanosaeta concilii*), isotopic enrichment factors (epsilon) ranged between -35 and +2 permil, possibly involving equilibrium isotope effects besides kinetic isotope effects. The values of epsilon were dependent on the acetate-catabolic pathway of the particular microorganism, the methyl or carboxyl position of acetate, and the relative availability or limitation of the substrate acetate. Patterns of isotope fractionation in anoxic lake sediments and rice field soil seem to reflect the characteristics of the microorganisms actively involved in acetate catabolism. Hence, it might be possible using environmental isotopic information to determine the type of microbial metabolism converting acetate to CO₂ and/or CH₄.