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The role of reactive intermediates (hydrogen, acetate) in anaerobic oxidation of methane (AOM) in marine sediments - kinetic versus thermodynamic control

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Reaction-transport models typically describe the degradation of organic matter by including particulate carbon pools of varying reactivity. Existing models, however, rarely represent the extracellular enzymatic hydrolysis of the particulate organic compounds to lower molecular weight compounds, followed by the fermentative production of reactive intermediates such as hydrogen and acetate. The concentrations of these intermediates are believed to play a major role in determining the thermodynamic viability of anaerobic oxidation of methane (AOM) - a microbially-mediated process of global significance. Therefore, we have developed a new organic carbon degradation model, which accounts for production of hydrogen and acetate and have incorporated it into an early diagenetic reaction-transport code. The explicit representation of substrate degradation pathways (including sulfate reduction, methanogenesis and AOM) allows us to asses the role of competitive inhibition among pathways, and to elucidate the kinetic and thermodynamic controls on AOM in marine sediments. This work forms part of the EU-project METROL (Methane Flux Control in Ocean Margin Sediments).