Iron reduction in deep methanogenic sediments coupled to anaerobic oxidation of methane - drivers and players

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Iron reduction by anaerobic oxidation of methane (AOM) was identified in the deep methanogenic zone of lake sediments. By conducting anoxic slurry experiments with sediments from this zone amended with ^{13}C-labeled methane and different iron oxide minerals we provide conclusive insight into the iron-coupled AOM process. This process was evidenced by significant ^{13}C enrichment of the dissolved inorganic carbon pool (DIC), while surprisingly the less reactive iron minerals such as magnetite and hematite were more accessible to the process. Inhibition of sulfate reduction led to enhanced ^{13}C-DIC production, suggesting a competition of methane oxidizers with sulfur oxidizers on the iron. Our microbial and lipid results indicate that the mechanism of iron-driven AOM is accomplished by a complex microbe community. We suggest that this microbe-mineral reaction network is being likely representative of many similar but hidden interactions sustaining life under highly-reducing low energy conditions such as deep aquatic sediments.