The Role of Minerals in Cryptic Methane Cycling in Marine Surface Sediment

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Methylamines are ubiquitous small organic carbon compounds in marine sediment, serving as important carbon and nitrogen sources for marine microbes. Recently, it was found that methylamines are the major substrates for methane production in marine surface sediment and thus a cryptic methane cycling exists in the upper layer of marine sediment [1, 2]. These methylated substrates are present at low concentrations in marine pore water, but high in the solid phase, showing high affinity to minerals [3]. This solid phase partitioning presumably limits their availability to methanogenic archaea and may exert a primary control over methane production in marine surface sediment. So far, it remains elusive about how methylamines and minerals interact and to what extent methane production is affected as a result of this interaction. To investigate the interaction of methylamines and minerals, we are performing adsorption and co-precipitation experiments using methylamines and ferrihydrite under different C / Fe ratios, followed by abiotic desorption and biotic microbial degradation experiments to test the stability of the mineral-organic complexes and thus the extent to which the complexes buffer and control the concentration of methylamines in pore waters. We also investigate the mechanism of methylamines and mineral sorption using micro- and nano-scale techniques, including STXM-NEXAFS. Sorption of methylamines to ferrihydrite increases linearly with initial C / Fe ratios. Our results will significantly contribute to understanding of the role of minerals in methane cycling in marine surface sediment.

References:

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