Biogeochemical cycle of methanol in anoxic deep-sea sediments of the eastern Japan Sea

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Methanol is one of the most important carbon and energy sources in anoxic environments. However, the biological flux and lifetime of methanol in anoxic marine sediments are largely unknown. In this study, we report quantitative methanol removal rates in deep-sea sediments from the Umitaka Spur in the eastern Japan Sea for the first time.

Methanol concentration in pore water was maintained at low concentrations ranging from 0.3 to 3.2 μM in shallow sediments above the sulfate-methane transition zone. However, it began to increase gradually from the depth below the SMTZ to approximately 20 μM near the bottom of the core at approximately 30 m below the seafloor.

Based on anaerobic incubation experiments with ^{14}C-labeled methanol, high rates of microbial methanol consumption were detected in the sediments. Our experiments also showed that the methanol oxidation to CO_2 surpassed methanol assimilation and methanogenesis from CO_2/H_2 and methanol. Nonetheless, a significant decrease in methanol was not observed after incubation, likely because of the microbial production of methanol in parallel with its consumption. The produced methanol is interpreted as metabolic intermediates during the microbial degradation of organic matter, such as lignin, pectin, and carbohydrates, under anoxic conditions. This study suggests that microbial reactions play an important role in the sources and sinks of methanol in subseafloor sediments.