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The Efficiency of the Benthic Filter – Biological Control of the Emission of Dissolved Methane from Sediments Hosting Shallow Gas Hydrates

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In sedimentary environments microbial methanotrophy represents an important sink for methane before it leaves the seafloor and enters the water column. Using novel benthic observatories in conjunction with numerical modeling of pore water gradients we investigated seabed methane emission rates at cold seep sites with underlying gas hydrates at the two contrasting regions Hydrate Ridge, (Cascadia margin), and the northern Gulf of Mexico. At both sites occurrence of microbial mats of the genus *Beggiatoa* apparently is coupled to the presence of shallow gas hydrates, the strength of sulfide flux and the velocity of advective pore water flow. However, type of venting and biogeochemistry at both sites is highly different, which might affect seabed methane emission. At Hydrate Ridge characterized by active fluid and gas venting, seabed methane efflux from microbial mat sites varies from 1.9 to 11.5 mmol m^{-2} d^{-1}. Methane consuming efficiency at these sites is about 66 %. At Hydrate Ridge we found a strong susceptibility of methane seepage from the availability of oxygen in the bottom contact water, emission rates of up to 113 mmol m^{-2} d^{-1} were measured under anoxic conditions. At the Gulf of Mexico oil venting additionally to gas and fluid seepage introduces high amounts of organic carbon into the benthic system and water column. Seabed methane emission in this region is comparable to Hydrate Ridge and ranges from 0.3 to 7 mmol m^{-2} d^{-1}. Beside anaerobic methane oxidation, our measurements indicate a high potential capacity of aerobic methane oxidation in the benthic boundary layer. This layer potentially restrains seabed methane emission when anaerobic methane oxidation in the sediment becomes saturated or when methane is bypassing the sediment matrix along fractures and channels.