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Seasonal dynamics of microbial sulfate reduction in temperate intertidal surface sediments: Controls by temperature and organic matter

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The role of microbial sulfate reduction on organic matter oxidation was studied quantitatively in different temperate intertidal surface sediments of the German Wadden Sea (southern North Sea) on a seasonal base. The sampling sites represent the range of sediments found in the backbarrier tidal area of Spiekeroog Island: Sands, mixed and muddy flats. The correspondingly different contents in organic matter, metals, and porosities lead to significant differences in the activity of sulfate-reducing bacteria with volumetric sulfate reduction rates (SRR) in the top 15 cm of up to 1.4 μmol cm-3 d-1. Depth-integrated areal SRR (top 15 cm) ranged between 0.9 and 106 mmol m-2 d-1, with highest values found in the mud flat sediments and lower rates measured in sands at the same time, demonstrating the importance of both, temperature and organic matter load. Considering the established temperature dependence and impact of organic contents, areal rates for the intertidal backbarrier area are calculated for the different seasons. According to the modelling results, in the top 15 cm of a 154 km2 large tidal area, about 39, 122 and 285 tons of sulfate are reduced per day, during winter, spring/autumn and summer time, respectively. Hence, the importance of areal benthic organic matter mineralization by microbial sulfate reduction increases during spring/autumn by a factor of about 2 and during summer by a factor of 7 when compared to winter time. The combined results correspond to an estimated benthic organic carbon mineralization rate via sulfate reduction of 78 g C m-2 y-1.

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