Nitrite as a key intermediate in N_2O formation in iron(II)-containing and carbon-rich marine sediments

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Nitrous oxide (N_2O) is an important greenhouse gas and contributes to stratospheric ozone depletion. In addition to microbial denitrification and ammonium oxidation, abiotic nitrite reduction by Fe(II) (chemodenitrification) has the potential to be an important source of N_2O in iron- and carbon-rich habitats. Here we present data from microcosm experiments with organic-rich coastal sediments from Norsminde Fjord (Denmark) to evaluate the contribution of N_2O formation by nitrite that is formed as an intermediate during heterotrophic nitrate reduction. The microcosms were amended with various combinations of Fe(II), nitrate and nitrite. We quantified all relevant N- and Fe-species, followed the shifts in microbial community composition and quantified the abundance and expression of genes involved in N-cycling over time. The comparison of sterile and microbially active microcosm experiments revealed that in nitrite amended sediments, a maximum of 25% of total N_2O production was caused by chemodenitrification. Our study suggests that chemodenitrification can contribute substantially to N_2O formation in the environment and therefore has to be considered for global budget calculations.