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The effect of future warming on carbon remineralization by iron- and sulfate-reducing bacteria in sediments of a glaciated Arctic fjord

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Sediments of glaciated Arctic fjords are biogeochemical active interfaces connecting the cryosphere and terrestrial ecosystems with the open ocean. They are hotspots of carbon burial and especially prone to climate change. Due to the Arctic amplification, they are warming faster than most other areas on Earth, with yet mostly unknown consequences for sediment biogeochemistry. Microbial iron and sulfate reduction are typically the most important processes for anaerobic carbon remineralization in these sediments. We conducted anoxic microcosm incubations with sediment from Kongsfjorden, Svalbard, (114 m water depth) to identify microorganisms involved in these processes via RNA stable isotope probing (RNA-SIP). To simulate the effect of future warming, incubations were done at 4°C (current temperature) and 12°C (expected in 50 years). We added either ^{13}C- or ^{12}C-acetate (500 µM) and to some treatments also ferrihydrite (5 mM) and/or molybdate (20 mM). Over time of incubation, we followed concentrations of dissolved and solid-phase Fe, H_2S, and measured sulfate-reduction rates (SRR) with a $^{35}S\text{-}SO_4^{2-}$ tracer. We furthermore followed the $\delta^{13}C$ signal of CO_2 in the headspace to confirm the utilization of the added acetate.

Our results show that the addition of acetate stimulated sulfate reduction, with SRR approximately three times higher than the unamended control. During the 15-day incubations, at 4°C SRR remained at the same level, while at 12°C SRR continuously increased and were about 10-times higher at the end. The addition of ferrihydrite stimulated iron reduction, indicated by the decrease of poorly crystalline ascorbate-extractable Fe(III) over time. However, the corresponding increase in dissolved Fe(II) was only minor. Together with undetectable H_2S and the measured SRR, this indicates a close interplay of iron and sulfur cycles in this system. Results from RNA-SIP show that *Arcobacteraceae* are predominately responsible for Fe reduction at 4°C while *Colwelliaceae* predominate at 12°C. Surprisingly, classical sulfate reducing bacteria had a reduced abundance in the heavy fractions compared to the ^{12}C control, also when SRR were increasing. The results highlight the sensitivity of the bacterial community and their associated metabolic processes towards warmer temperatures and that this has the potential to change the biogeochemistry of fjord sediments.