Impacts on benthic microbial communities by artificially enhanced weathering as a CO_2 removal strategy

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Atmospheric CO_2 levels have increased dramatically since the industrial revolution, resulting in a warming of Earth's climate. The global ocean is fundamental for helping to slow down global climate change by taking up heat and CO_2 from the atmosphere. This has resulted in rapid changes of the oceans including higher water temperature, deoxygenation and acidification affecting oceanic life and biogeochemical cycling. To mitigate or even counteract anthropogenically induced changes to Earth's climate and achieve the goals of the 2015 UN agreement, anthropogenic CO_2 emissions must be actively removed from the atmosphere and stored over long timescales. One of the currently tested CO_2 removal strategies is ocean alkalinity enhancement (OAE) by enhanced benthic weathering (EBW) via addition of alkaline minerals to surface marine sediments. However, feedback mechanisms between microbial activity in surface sediments and EBW are currently unresolved. This study investigates the effects of mineral addition and dissolution on the benthic microbial community and possible feedbacks related to community shifts. For this purpose, incubation experiments were conducted where dunite and calcite were added to organic-rich sediments from the Baltic Sea that in nature are exposed to seasonal hypoxia/anoxia. Changes in the microbial communities over time were monitored via RNA-profiling and microscopy. Low oxygen experiments demonstrated significant shifts in the microbial community following mineral addition. For example, an increase in cable bacteria abundance was evident after adding calcite, while sulfate reducing bacteria became enriched in sediments amended with dunite. This is the first study demonstrating that artificial EBW using calcite promotes cable bacteria activity under low oxygen conditions. We discuss possible microbe-mineral interactions and the potential impact on the efficacy of EBW as a potential CO_2 removal strategy.