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Influence of freeze-coring on potential methane production rates in freshwater sediment

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Field studies over the last decades show that sediment in freshwater impoundments can act as an important source of greenhouse gases (GHG) like methane and carbon dioxide (Cole et al., 2007; Maeck et al., 2013). Under anaerobic conditions, enhanced mineralisation of organic matter within the sediment favours methane bubble formation. To investigate the influencing sediment parameters and relevance of the emissions, undisturbed sediment cores are needed. A suitable sampling technique should retain the in situ sedimentological, biological and chemical conditions.
Disadvantages of using common tube samplers, such as gravity corers, to sample water-saturated or gas-bearing sediment, may include degassing of the bubbles in the sediment column, and/or liquifaction of the sample. A simple and robust freeze corer, developed at Cologne University of Applied Science, freezes the sediment inside of a double-walled tube overcomes these disadvantages.
However, the process of freezing and thawing does influence the microbial community or organic matter characteristics within the sediment and therefore the methane and carbon dioxide production. Potential gas production rates can be determined through laboratory sediment incubation experiments. Correlations between sedimentological properties and potential methane production rates help to explain the causes for enhanced emission from reservoirs and assess the emissions relevance related to a certain reservoir.
To analyse the influence of an artificial freeze-thaw-event on the potential methane and carbon dioxide production, several sediment samples were taken at two different reservoirs in Germany (Urfttalsperre & Olsberg reservoir). The new freeze-corer and a gravity-corer were used as sampling devices. Sediment from different depth layers was incubated in the laboratory to measure the potential CH4 and CO_2 production.
First results show significant differences of more than 10 mgl-1d-1 in CH4 and CO_2 production in the upper sediment layers between the frozen and non-frozen samples.
Further analyses are ongoing to define potential distinct patterns within the differences allowing the determination of a transformation standard between freezing influenced potential methane production rates and unaffected ones.

Literature:
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