Extreme gas production from fibrous sediments - a potential overlooked greenhouse gas source

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Introduction: Fibrous waste products originating from the pulp and paper industry were historically discharged into water bodies. In Sweden, submerged banks of contaminated fibrous material called "fiberbanks" are found in coastal areas and lakes [1,2]. Similar fibrous deposits have also been found in other countries (e.g. Canada and Finland [3,4]). Fiberbanks are often contaminated with metals and persistent organic pollutants [1,2]. Through degradation and anaerobic methanogenesis the organic material that fiberbanks are composed produces gases. A majority of the surveyed fiberbanks in Sweden show signs of gas ebullition (bubbles and/or pockmarks at the sediment surface). In this study, we present results from controlled laboratory experiments aiming to identify and quantify the gas release from Swedish fiberbanks over a range of temperatures.

Methods: Several incubation experiments were performed between 4 and 20°C for two different types of fiberbank sediments. X-ray tomography was used to study the time-dependent development of gas voids within the sediment. A specifically designed optic sensor was used to measure the volume of gas released at various temperatures by measuring the number of bubbles and their size. The gas composition was analyzed with a Biogas 5000 instrument. Methane production was measured after incubation at various temperature with an Ultraportable Greenhouse Gas Analyzer.

Results: The fiberbank sediments produce high amounts of methane and carbon dioxide, which are potent greenhouse gases. Gas production from fiberbank sediments is strongly correlated with temperature. X-ray measurements showed that larger gas voids were formed over time in fiberbanks with a finer fibrous structure compared to a coarser sediment composed of wood pieces.

Discussion: The high methane production measured from fiberbank sediments in the laboratory is much higher than other types of sediments reported in the literature. Hence, further field measurements are needed to quantify fiberbanks' contribution to Sweden's greenhouse gas release budget. These findings stress the need of remediation of these fiberbank sites, not only to limit contaminant dispersal but also to reduce this uncontrolled release of greenhouse gases to the atmosphere. In addition, the extensive gas production may have implications for potential remediation options.

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