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Influence of organic matter quality on organic matter degradability in river sediments

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The project BIOMUD, part of the scientific network MUDNET (www.tudelft.nl/mudnet), investigates the decomposition of sediment organic matter (SOM) in the Port of Hamburg. The microbial turnover of sediment organic matter under reducing conditions leads to the formation of methane, carbon dioxide and others gases causing a change in the sediment rheological parameters. BIOMUD is aiming to explain the effect of organic matter lability on the rheological properties impacting the navigable depth of the harbour.

Samples of freshly deposited material were taken in 2018 and 2019 at nine locations in a transect of 30 km through the Port of Hamburg. Analyses included abiotic parameters (among others grain size distribution, standard pore water properties, standard solid properties, stable isotopes, mineral composition) and biotic parameters (among others anaerobic and aerobic organic matter degradation, DNA, protein and lipid content, microbial population). At four locations, physical density fractions and chemical organic matter fractions were analysed.

The quality of organic matter was described by normalising carbon released from microbial degradation under both aerobic and anaerobic conditions to the share of total organic carbon (mg C/g TOC). Organic matter pools with different degradation rates were used to quantify the lability of organic matter. The share of faster degradable (more labile) pools correlated strongly with the size of the hydrophilic DOC fraction, confirming results of Straathof et al. (2014) who investigated dissolved organic carbon pools in compost. The hydrophilic DOC fraction was closely correlated to the polysaccharide concentration, explaining the input of easily degradable organic matter. Moreover, the amount of organic carbon present in the sediment's light density fraction < 1.4 g/cm^3 strongly correlated with the hydrophilic DOC fraction and, less strongly, with organic matter lability. High organic matter quality, i.e. the labile, easily degradable fraction, was further related to the chlorophyll concentration in the water column but also the ammonium concentration in the sediment's pore water.

It was hypothesised that the observed toposequence of decreasing organic matter quality from upstream to downstream could be explained by a chronosequence of increasing degradation and therefore ageing of organic matter as the sediment passes through the harbour area. Further, it

was hypothesized that the harbour received organic matter of higher degradability, originating from phytoplankton biomass, from the upstream part of the Elbe river, whereas the input from the tidal downstream area provided organic matter of lower quality (degradability).

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