Fate and transport of nitrogen in soils, sediment and water of the Lena Delta, Northeast Siberia

Tina Sanders, Matthias Fuchs, Kirstin Dähnke

Introduction

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

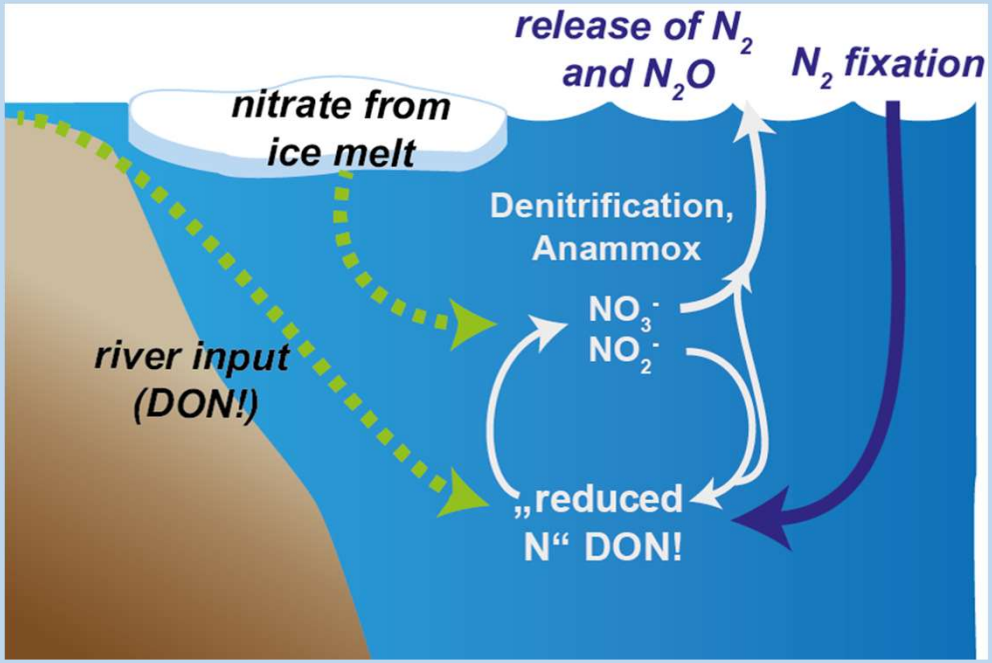
Soils and sediments in the Lena Delta in Northeast Siberia store large amounts of organic matter including organically bonded nitrogen. This nitrogen is not directly available for plants and primary production, but can be remineralized in the soils or after erosion to the Lena River.

Our study aims to estimate the load of reactive nitrogen from terrestrial sources into the Arctic Ocean. Therefore, water and sediment samples were collected along a transect (~200 km) from the centre of the Delta to the open Laptev Sea in summer 2019.

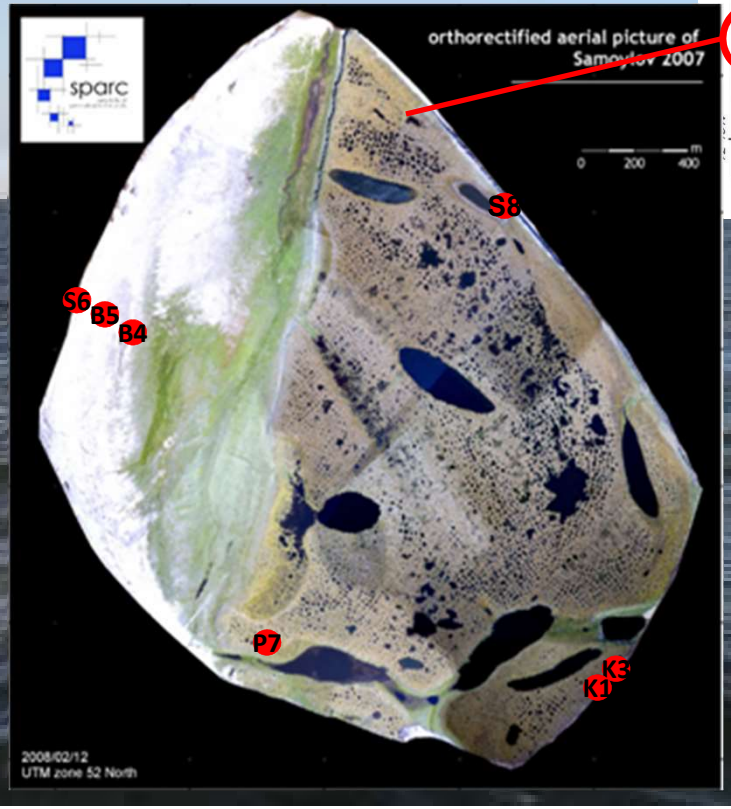
On the collected samples, we will measure dissolved organic and inorganic nitrogen, particulate nitrogen and CN ratio. In addition, the ^{15}N stable isotope values of these components will be determined to identify source, sinks and processes of nitrogen alteration.

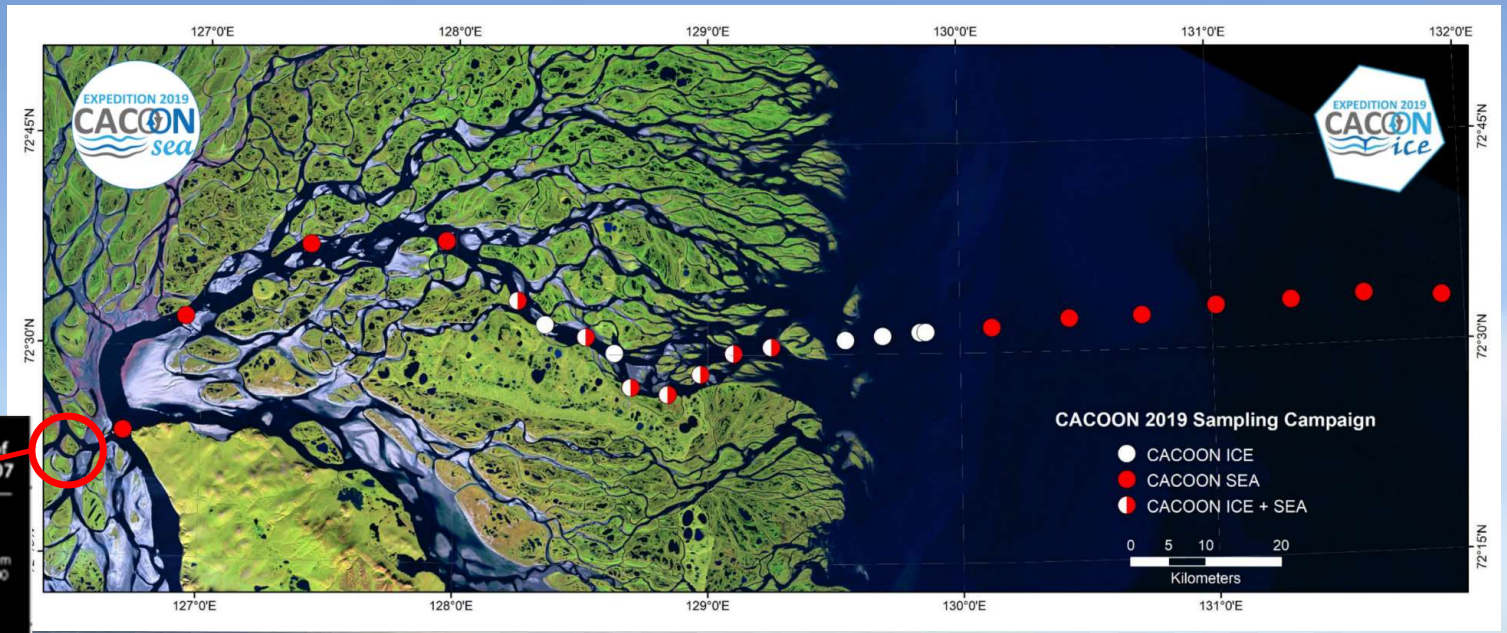
Additionally, we carried out incubation experiments during the field visit in order to determine the potential remineralisation rates of various soil types and sediments in Lena water. The organic matter content of the soils varied from 1 to 45 % and shows high variability. With our study we highlight the importance to include the fate of nitrogen in a changing Arctic environment.

Nitrogen Cycle in coastal Arctic

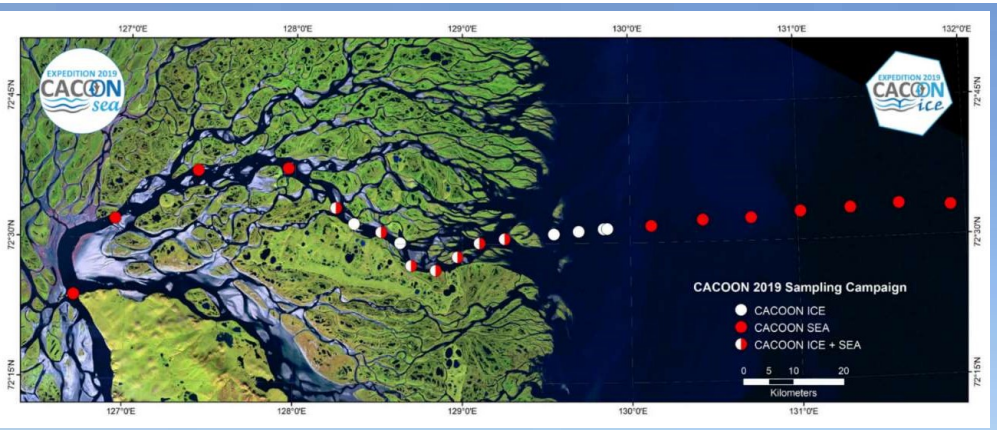


Soil and Sediment Incubation: Samolyov Island

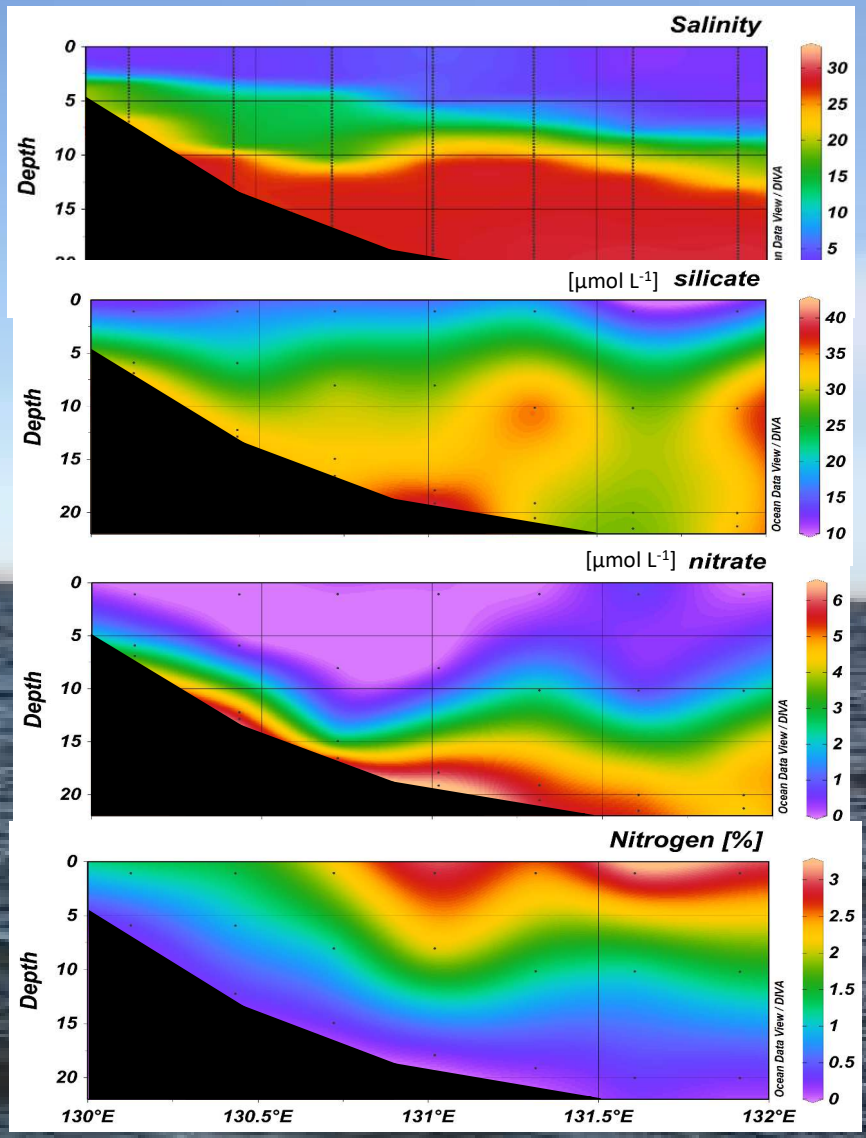




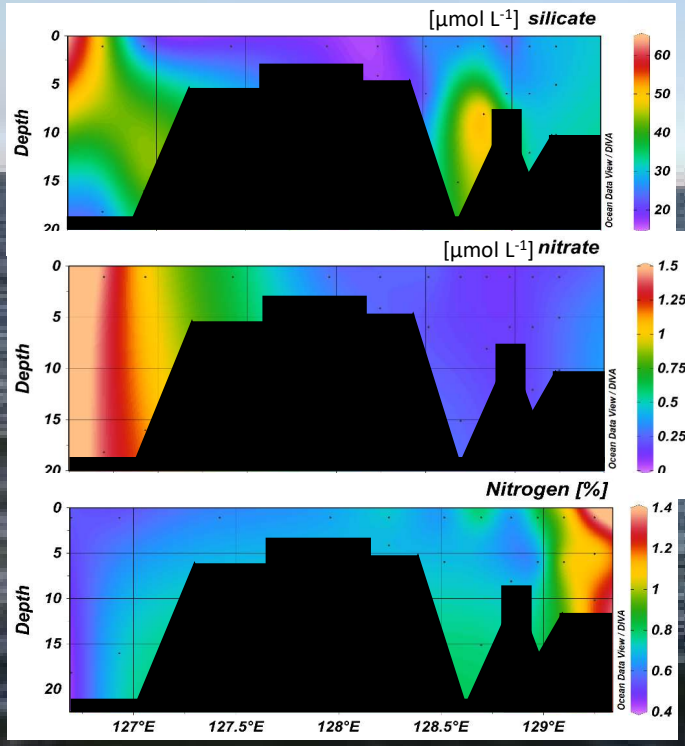
Lena River and Laptev Sea transect



Laptev Sea Transect



Lena Transect



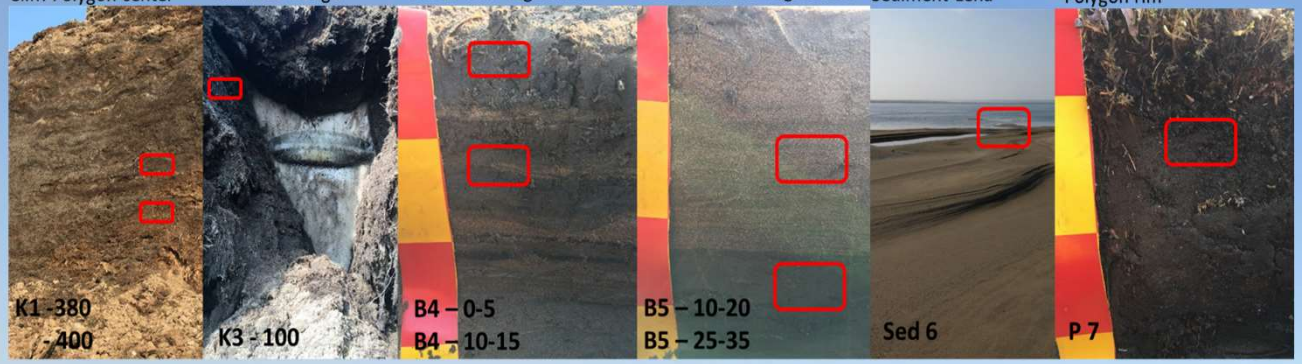
LENA

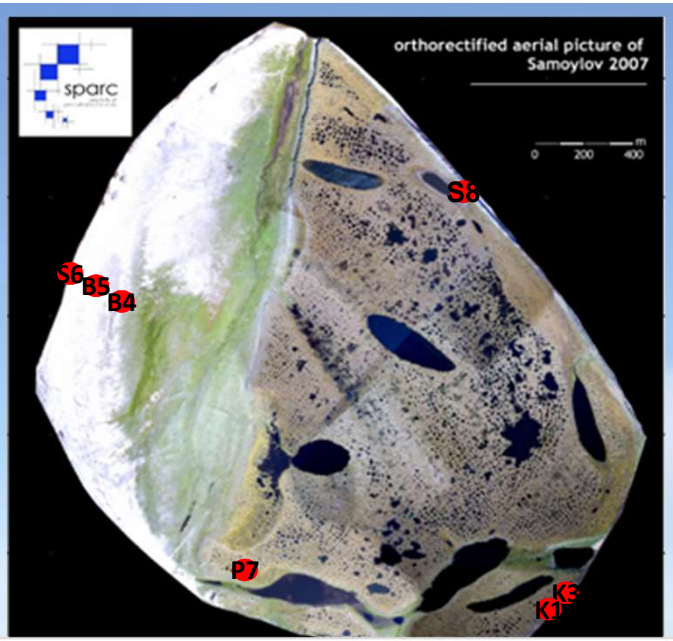
- Decrease of nitrate and silcate from the center of the Delta
- Increase of nitrogen in SPM
- ➢ Evidence for a phytoplankton bloom in the Delta

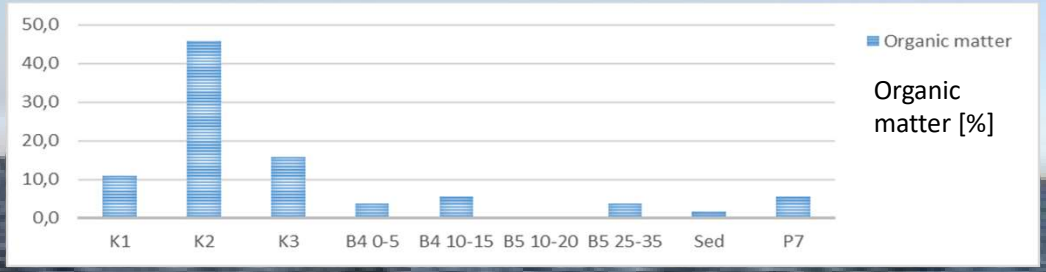
LAPTEV SEA

- Strong stratification
- Marine water silicate and nitrate rich
- No DIN transport from the Delta into the Laptev sea in summer
- Phytoplankton bloom in the surface water

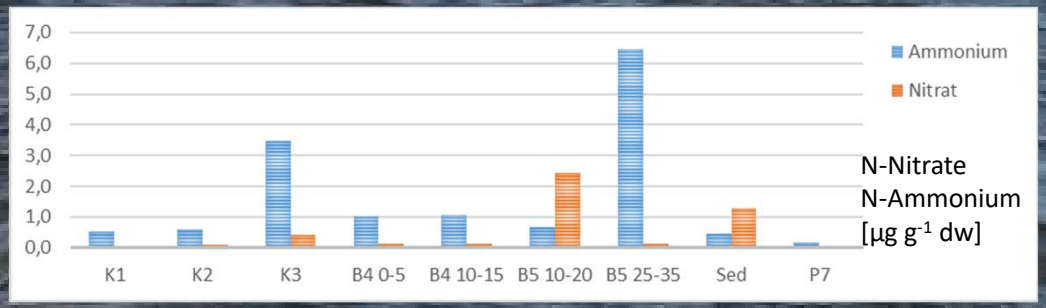
Soil Incubation in Lena water



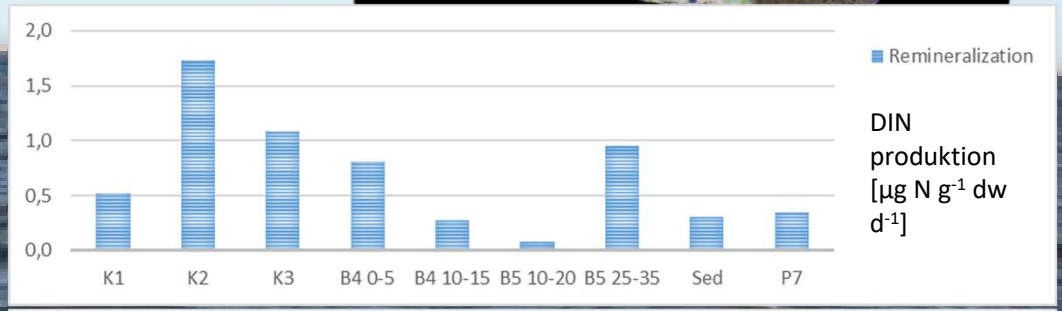




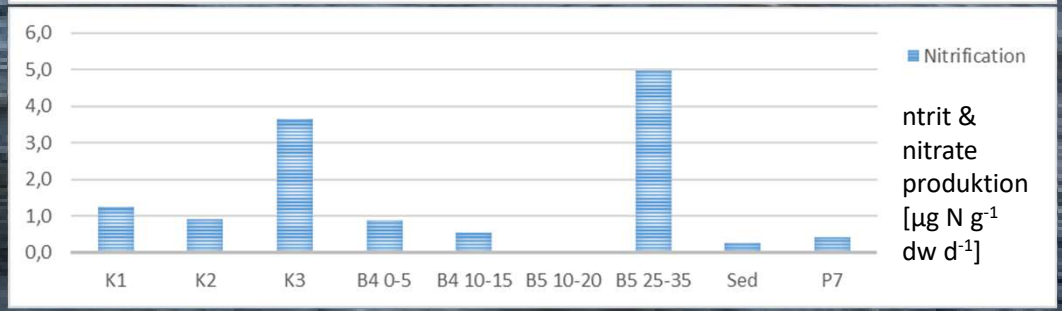
Organic matter [%]



N-Nitrate
N-Ammonium
[µg g^{-1} dw]



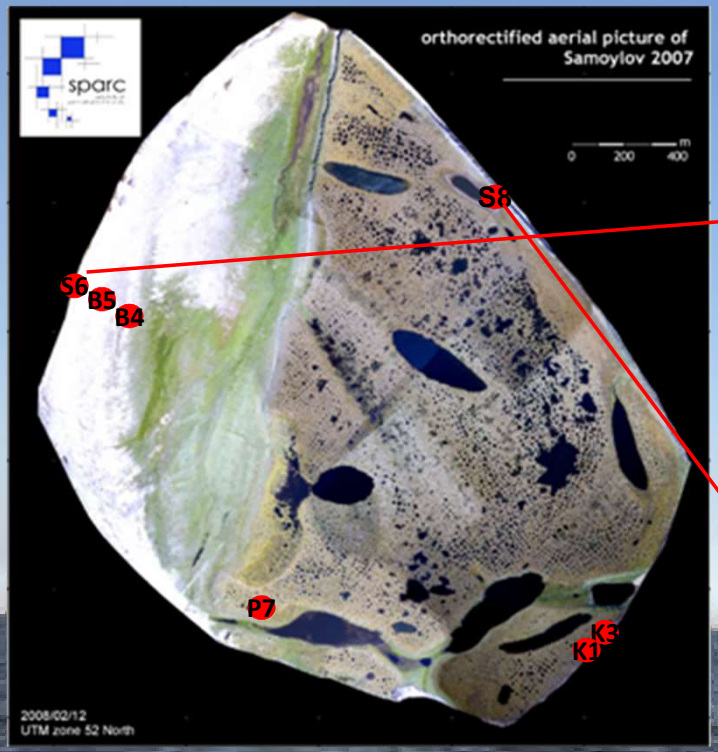
DIN produktion [µg N g^{-1} dw d^{-1}]

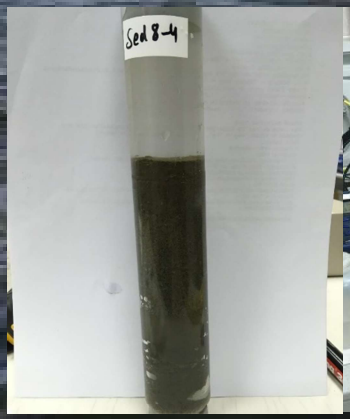


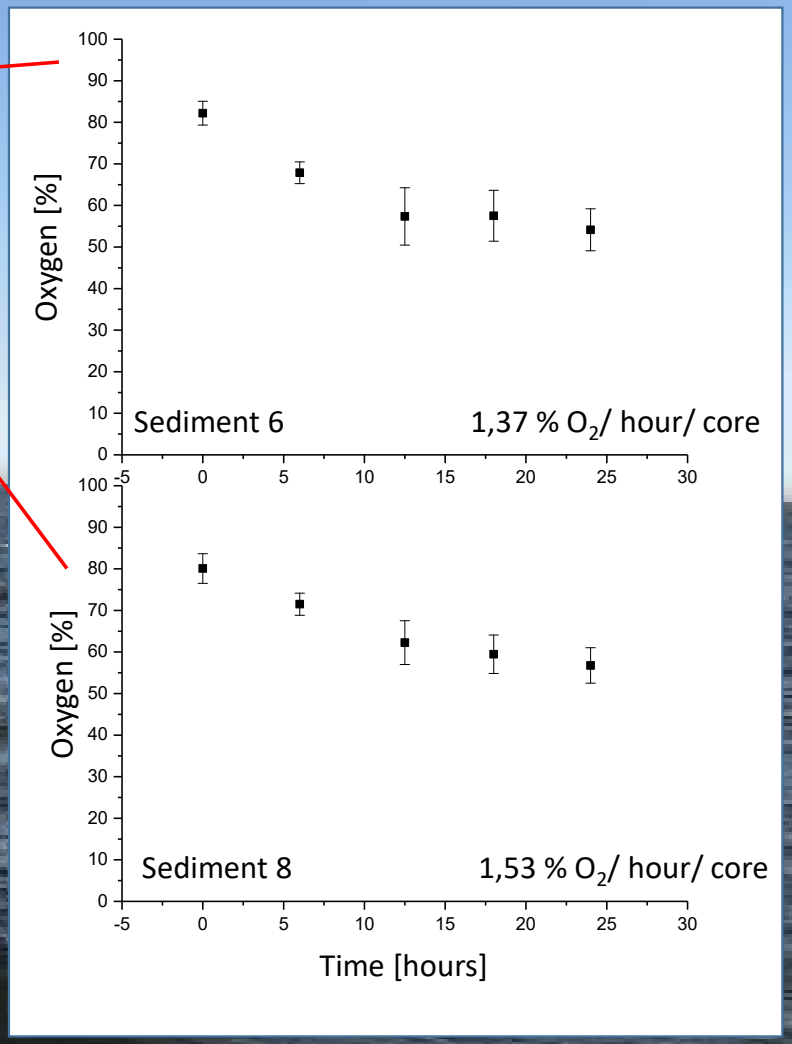
ntrit & nitrate produktion [µg N g^{-1} dw d^{-1}]

Organic matter content and ammonium content correlates with remineralisation and nitrification, respectively

Sediment core incubation







- Significant Oxygen depletion in the first 12 hours
- No significant different between the site 6 and 8
- No significant nutrients fluxs (Ammonium, nitrite, phosphate and silicate) over 24 hours
- Nitrate flux in the sediment of approx. -350 µg N Nitrat /m^2 / d

Conclusion and Perspective

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

Main Results

- Nitrogen mainly bonded in organic matter
- Dissolved inorganic nitrogen (DIN) in soils mainly as ammonium
- Nitrate in Lena Sediment and in the floodplain without vegetation
- Remineralization and Nitrification of organic nitrogen in soils and Lena after erosion
- Lena Sediment are nitrate sinks
- Nutrient fluxes to the River stimulate phytoplankton bloom

What next?

- Measurement of stable isotopes of nitrate ($\delta^{15}N$ and $\delta^{18}O$)
- Measurement of total nitrogen und dissolved organic nitogen

Open question

Are the soils of the floodplain and beach und the sediments of the Lena sources of N2O?