Pore Water Profiles In Intertidal Sediments From The German Wadden Sea

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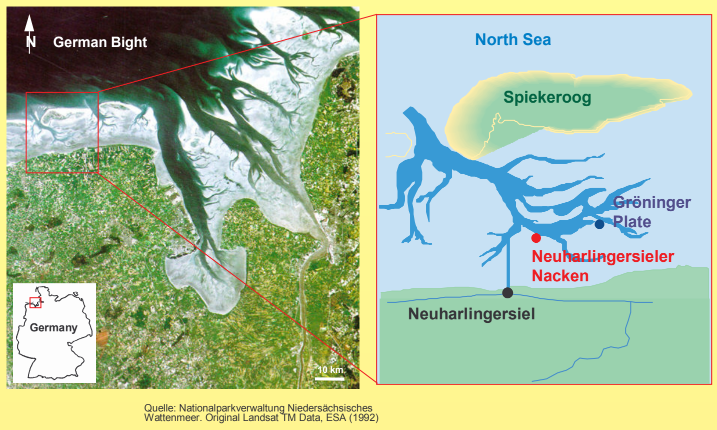
Introduction

Most studies of Wadden Sea sediments are restricted to near-surface sediments. Little information is presently available on deeper sediment layers. Sediment cores up to a depth of 5.5 m from different locations in the backbarrier tidal flats between the island of Spiekeroog and Neuharlingersiel provide an insight into this largely unknown shallow subsurface bio- and geosphere.

This poster shows the composition of sediments and pore waters at two locations: Neuharlingersieler Nacken and Gröninger Plate. Sediment cores were taken in June 2002, October 2003, and February 2004 to study temporal variations.

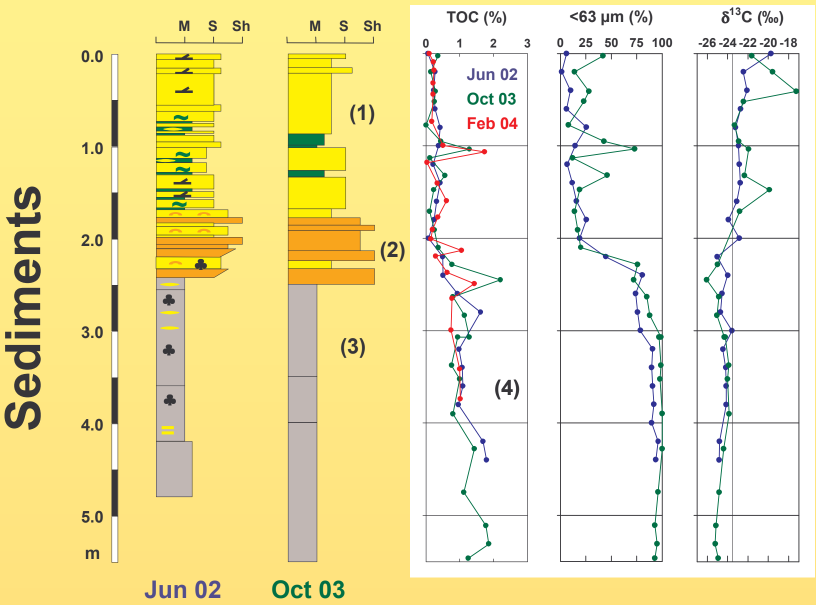


Location of long sediment cores in the backbarrier tidal flats between Spiekeroog Island and Neuharlingersiel (NW-Germany)

Results

Neuharlingersieler Nacken

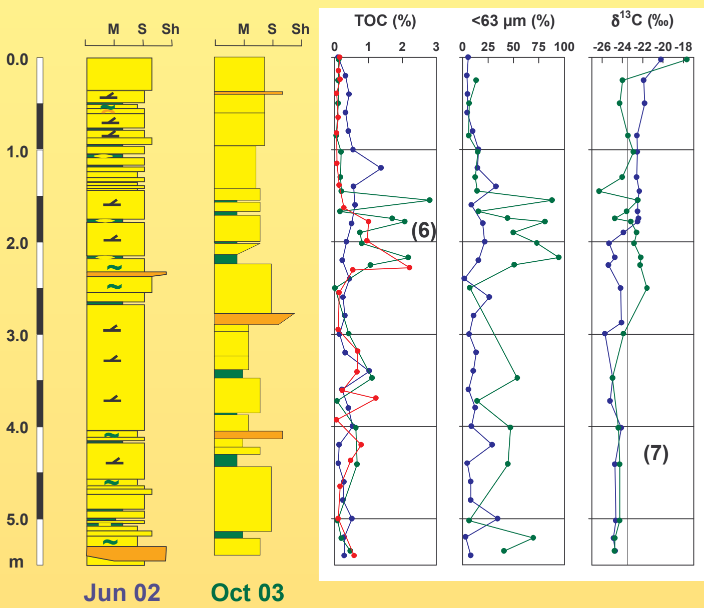
Sediments



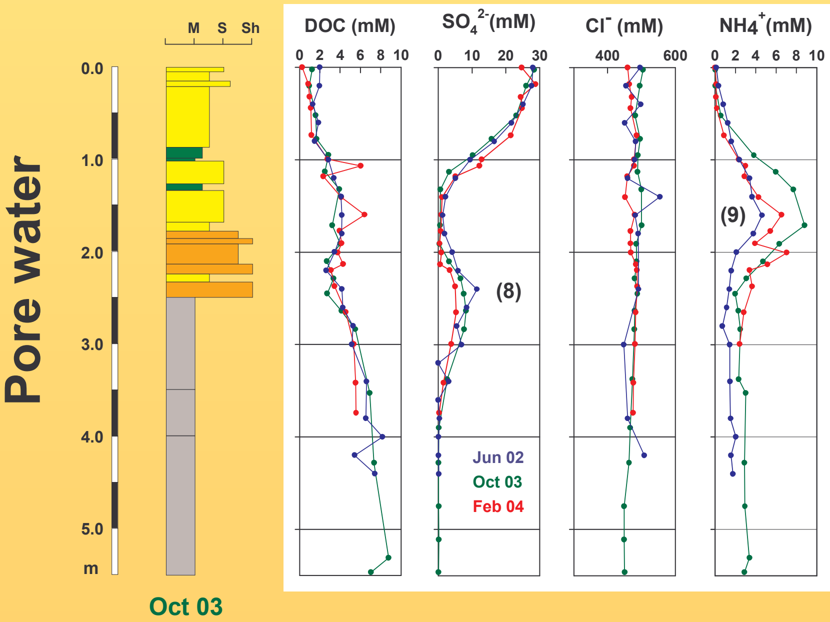
The upper part of the sediment cores from Neuharlingersieler Nacken (left) comprises mixtures of fine sand and mud with sedimentary structures typical for sand and mixed tidal flat deposits (1). An interval with shell-rich layers (channel deposits, ca. 1.8 to 2.5 m depth; 2) overlay grey mud (salt marsh deposits; 3) with elevated TOC content (4) and a higher portion of terrigenous organic matter (5).

Gröninger Plate cores (right) comprise sand flat and mixed tidal flat sediments. Between ca. 1.5 and 2.5 m depth mud- and TOC-rich layers are more frequent (6). In the deeper part of the core organic matter of terrigenous origin is relatively more abundant (7).

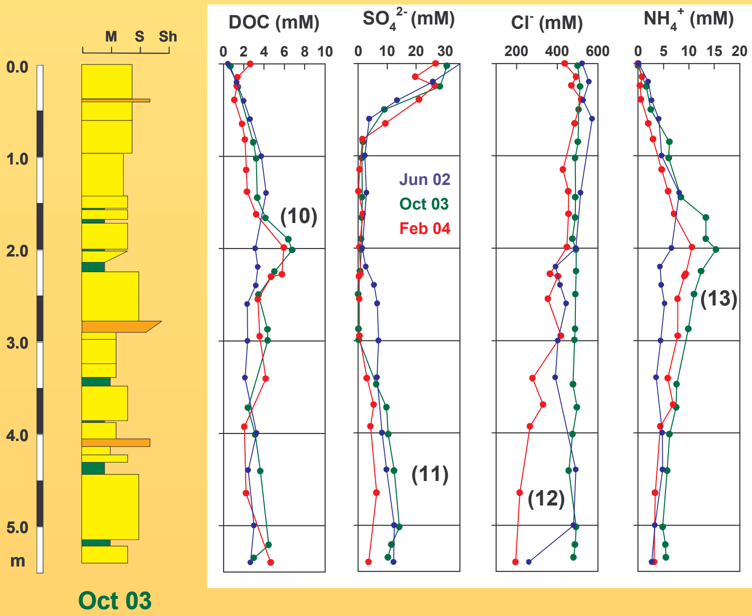
Gröninger Plate



Pore water



Neuharlingersieler Nacken (left):
Dissolved organic carbon (DOC, <0.2 µm filtrate) increased with depth from <2 mM near the surface to ca. 7 mM in the grey mud in the lower part of the cores. Sulfate had a concentration of ca. 30 mM at the surface and was almost absent between 1.2 and 2 m depth. A second asymmetric sulfate maximum (8) between 2 and 3.5 m indicates a lateral inflow of sulfate-containing water through the shell-rich interval. The sulfate apparently diffuses downward into the low-permeable grey mud (gentle gradient). Microbial sulfate consumption may cause the steeper upward gradient into the overlaying sand. Ammonium concentrations show a maximum in the zone where sulfate is low (9).



Gröninger Plate (top):
Pore water DOC showed a gentle maximum between 1.5 and 2.5 m associated with the occurrence of mud-rich layers with elevated contents of organic carbon (10). Sulfate decreased from ca. 30 mM at the surface and was almost absent from 0.9 to 3 m depth. Below, a second sulfate maximum occurred and extended downward to more than 5.5 m depth (11). In February 2004 low chloride concentrations below 2 m depth were found (12). This suggests a lateral inflow of water depleted in sulfate and chloride into the lower part of the sediments. DOC values were apparently not affected. Highest ammonium concentrations were found where sulfate was almost absent (13).

Conclusions

- Sediments of the Neuharlingersieler Nacken core show a large variability concerning grain size, amount and type of organic matter, depositional environment, and physical properties.
- Pore water profiles of the investigated sediment cores from the Wadden Sea are complex. They result from a combination of microbiological processes, sediment properties, lateral inflow of sea water, and mixing with sulfate- and chloride-depleted water.
- Pore water profiles at both locations show many similar features. At Neuharlingersieler Nacken their vertical extension is restricted by underlying low-permeable grey mud.
- Dissolved organic carbon concentrations generally increase with depth, but are also influenced by the organic matter content of the sediments.
- The occurrence of a deep sulfate maximum indicates the lateral inflow of sea water at both locations.
- Temporal variations of the chloride concentration suggest mixing with sulfate- and chloride-depleted water at Gröninger Plate.

Acknowledgements

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