Microbial communities in Wadden Sea sediments

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Introduction

Coastal sediments are characterized by intense mineralisation of organic matter. While the microbial communities in the upper sediment layers are well investigated, there is a lack of microbiological data for depths deeper than 20 cm. In our present study we investigated sediment cores from the East Frisian Wadden Sea (Janssand) down to a depth of 150 cm.

Materials and Methods

Total cell counts (Sybr Green II direct counts) and most probable number (MPN) counts were determined in several sediment samples from 0.5 cm to 150 cm depth. MPN series were performed using eight different mixtures of growth substrates under oxic and anoxic incubations. From the highest positive MPN dilutions strains will be isolated, characterized physiologically and compared by molecular biology. Total DNA was extracted from the same sediment layers and analyzed by PCR/DGGE using eubacterial primers (GC 357f, 907r).

Results

Total cell counts

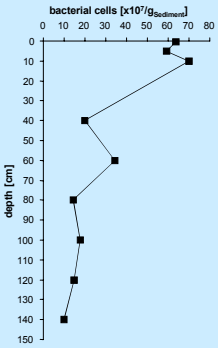

Fig. 1: Vertical profile of total cell numbers

- Sybr Green II cell counting revealed high bacterial cell numbers at the sediment surface and a strong decline within the first 40 cm.
- In the deeper sediment layers (80-140 cm) only little variations were detected.

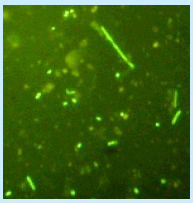

Fig. 2: Sediment bacteria stained with Sybr Green II

Most probable number

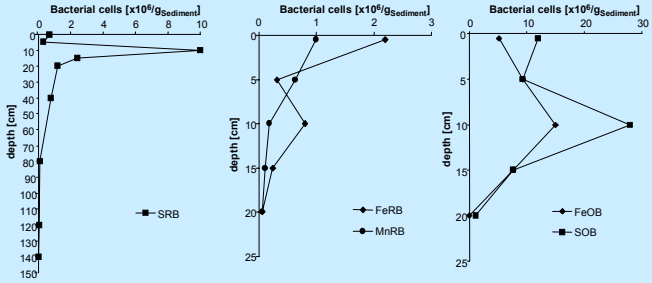

Fig. 3: Vertical profiles of sulfate reducing bacteria (left), ferric iron and manganese (IV) reducing bacteria (middle) and ferrous iron and sulfur oxidizing bacteria (right). Note different depth scales.

- Lower MPN counts were obtained within the first 15 cm of the sediment under anoxic than under oxic incubation.
- There was an obvious maximum of SRB, SOB, FeRB and FeOB in the depth of 10 cm corresponding with a maximum of Fe(II).
- Cell numbers of MnRB showed a maximum at the surface and declined with depth.
- Cultivation of MnOB was not sucessful.

Chemical parameters

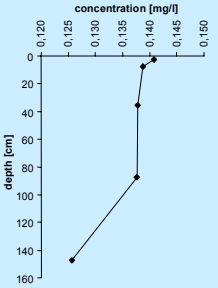

Fig. 4: Vertical profile of SO_4^{2-}/Cl^- in the sediment (analyzed by Sibylle Kölsch, TP 3)

- Only a slight decrease of SO_4^{2-}/Cl^- was observed.

DGGE

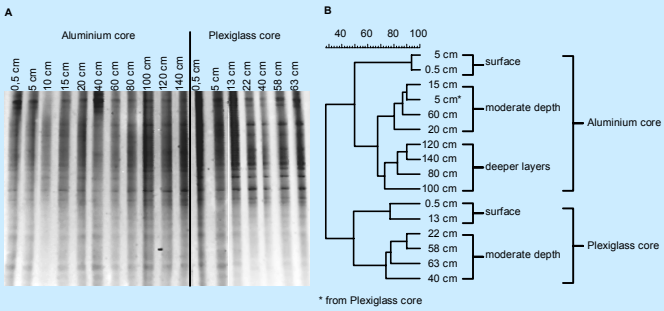

Fig. 5: Analysis of the vertical diversity from two different cores. **A** DGGE of the 550 bp fragment from two different cores; **B** dendrogram calculated on the basis of Pearson correlation and UPGMA.

- The surface ranged from 0.5 - 13 cm, the moderate depths from 15 - 63 cm and the deeper layers started at 80 cm.
- The dendogram from two cores (aluminium core, plexiglass core) showed similar vertical profiles with differences between layers.
- Due to different sampling methods, samples from the two cores fell into different clusters.

Dissolved free amino acids

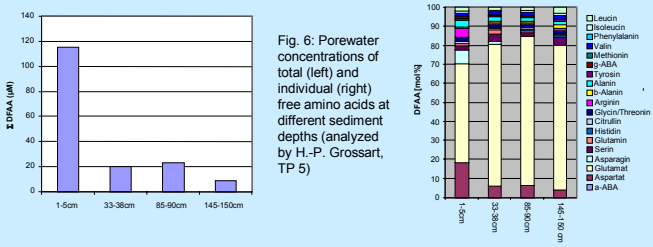

Fig. 6: Porewater concentrations of total (left) and individual (right) free amino acids at different sediment depths (analyzed by H.-P. Grossart, TP 5)

- Concentrations of dissolved free amino acids decreased rapidly with depth. In all samples, glutamate was the dominating amino acid accounting for 52-78% of total amino acids.

Conclusions

Total cell numbers and the MPN counts showed clear variations with the depth in the sediment. The bacterial community of the cores were divided into three sections by molecular analysis. The two sampling methods on the same location led to differences within bacterial communities of the corresponding layers. One main aspect of TP 6 - reaching sulfate free sediment depths - was not achieved. Therefore, for our approach Janssand seems to be unsuitable as a sampling location.

Group members

Fig. 7:from left to right: Reinhard Wilms, Heribert Cypionka, Beate Köpke, Jürgen Rüllkötter, Elke Freese, Henrik Sass, Ralf Wöstmann, Bert Engelen, Heike Rütters

Heribert Cypionka	pmbio	Head of Paleomicrobiology Group
Henrik Sass	pmbio	Cultivation, physiology
Bert Engelen	pmbio	Molecular biology
Reinhard Wilms	pmbio	Molecular biology: community structure; cultivation
Beate Köpke	pmbio	Cultivation, SRR, Fe, Mn analysis
Jürgen Rullkötter	ogc	Head of Organic Geochemistry Group
Heike Rütters	ogc	Phospholipid analysis, GC-MS, LC-MS
Elke Freese	ogc	Dissolved organic matter; bioavailability
Ralf Wöstmann	ogc	Terrestrial organic matter, stable carbon isotopes (GC-irm-MS)

Acknowledgements

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