Input / output budget and states of the backbarrier tidal flat water column

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Research Group
BioGeoChemistry of tidal flats
sub-project 3

Introduction

The goal of our sub-project is to elucidate the input/output of dissolved and particulate matter between the backbarrier and offshore areas. It is not known if the tidal flats are presently in a steady state or suffer a net loss of material. Therefore, we intend to study the tidal and seasonal dynamics of seaward and landward transport of dissolved and particulate material as well as its relation to the retention or mobilisation of specific compounds. These questions are addressed in three ways:

1. characterization, quantification and input/output balance of the dissolved and particulate load between the backbarrier tidal flats and the open North Sea through the inlet; on tidal and seasonal cycles and taking into account extreme events (severe storms and sea ice),

2. characterization and quantification of the terrigenous dissolved and particulate input from small tributaries into the backbarrier tidal flat system on a seasonal scale,

3. characterization and quantification of the biogeochemical transformation of dissolved and particulate matter in the water column of the backbarrier tidal area.

About us

Member	Group	Method	Parameter
Rainer Reuter Frank Terjung Heiko Manott Bernhard Wachowicz Klaus Loquay	Marine Physics	CTD polychromatic-transmissometer spectrofluoro-photometer UV/VIS-spectrometer	salinity, T, O_2 gelbstoff, suspended transparent particles phytoplankton dissolved gelbstoff chlorophyll
Hans-Jürgen Brumsack Bernhard Schnetger Sibylle Kölsch Olaf Dellwig	Microbiogeochemistry	coulometry XRF ICP-OES ICP-MS IC	bulk parameter major/trace elements in sediments, SPM, water (e.g. Al, Ca, Fe, Ba, Mn, Mo, U, REE) Br^-, Cl^-, NO_2^-, NO_3^-, PO_4^{3-}, SO_4^{2-}
Jürgen Rullkötter Sven Gebhardt	Organic Geochemistry	GC, GC-MS pyrolysis, C-NMR FT-IR, lq-lq-extraction lq-chromatography	humic substances degradation products low-molecular lipids
Gerd Liebezeit Heike Rickels	Marine Chemistry (Terramare)	C/N-analyser spectrofluoro-photometer	POC, TPN PIP, POP chlorophyll

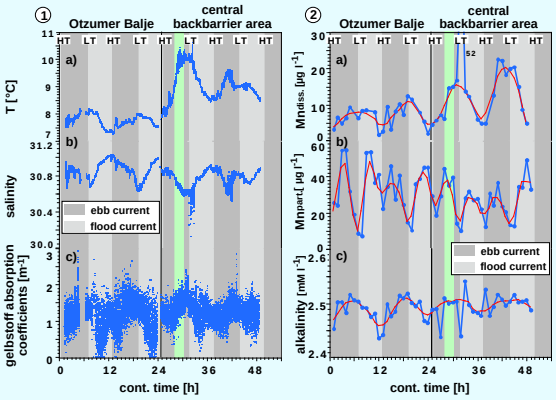


Fig.1 and 2: Tidal variation of physical and chemical parameters during a cruise with "FK Senckenberg" in April 2000. The green bar denotes open sluice.

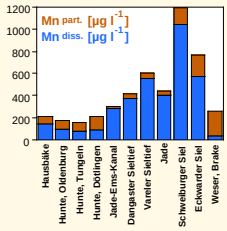


Fig.3: Dissolved and particulate Mn load of rivers and sluices close to the study area (Lipinski, 1999).

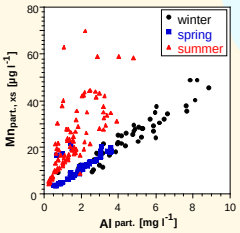
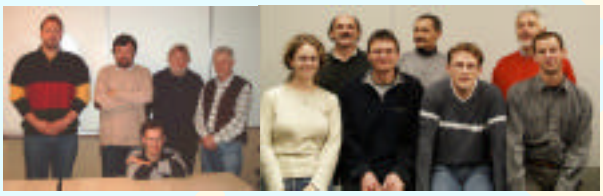


Fig.4: Seasonal variations of particulate Mn versus particulate Al load.
$Mn_{part.,\ xs}$ denotes excess Mn in comparison to the geogenic background.



Members of sub-project 3 (from left to right):
H. Manott, R. Reuter, F. Terjung, K. Loquay, B. Wachowicz, S. Kölsch, H.-J. Brumsack, B. Schnetger, G. Liebezeit, O. Dellwig, J.Rullkötter, S. Gebhardt

What do we learn from chemical and physical data?

Figure 1 shows the variation of temperature, salinity, and gelbstoff-absorption coefficients during tidal cycles close to the positions of the time-series stations (Otzumer Balje and central backbarrier area).
Dissolved Mn (Fig. 2a) shows a pattern similar to that of temperature and mirror images that of salinity, respectively. The Mn concentration increases during ebb current with maximum values at low tide. The particulate Mn load (Fig. 2b) correlates with current velocities, therefore showing minimum concentrations at tidal slacks. The alkalinity pattern is similar to $Mn_{diss.}$ reflecting microbial activity in the sediments and the release of soluble Mn^{2+} from the porewaters.
Besides porewaters, small coastal tributaries which drain into the backbarrier area are an important source for Mn and other elements. Figure 3 shows dissolved and particulate Mn concentrations of small rivers and sluices close to the study area (Lipinski, 1999, Diploma Thesis). Maximum values of about 1200 µg l^{-1} Mn show that the freshwater influence cannot be neglected (see also Fig 2a). Hence, anomalies in $Mn_{diss.}$, temperature, and salinity in the central backbarrier area (Fig. 1 and 2; 32 h) are caused by the discharge of freshwater through the open sluice (green bar).
Besides tidal cycles it is relevant to investigate seasonal variations which are shown in Figure 4. Highest $Mn_{part.}$ concentrations are observed during summer when microbial activity is high.
The investigation of organic material enables the characterization and quantification of the land-derived POM and DOM. This requires the comparision to peats and peat-forming plants in the coastal regions as well as the distribution patterns of biomarkers and their carbon isotopic ratios in water and sediment samples. An essential component of the DOC are humic substances which presumably are an important carrier for heavy metals.