Are water column signatures of the NW German backbarrier tidal flat influenced by microbial activity?

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Intertidal areas play an important role as an interface between the terrestrial and marine environment. To date they are still poorly understood particularly regarding the flow of minor and nutrient elements to the open ocean. The Wadden Sea Research Group, which was established at the Oldenburg institute, focuses on the interplay between biological, physical and chemical parameters in this very dynamic coastal system.

Microbial activity is seen in time series measurements of physical and chemical water column parameters, both on tidal and seasonal scales. Strong tidal variations in redox sensible elements like Mn are related to the contribution of pore waters draining from the flats during low tide, accompanied by variations in alkalinity. The importance of pulsed fresh water inflow through small rivers is still under debate, but may be of importance, too. The small DOC-rich tributaries of Northern Germany are characterized by significant particulate and dissolved Mn and Fe concentrations. Completely unknown is the role of the subterranean estuary system, which may inject ground waters directly into the backbarrier area.

On a seasonal scale significant differences are seen in particulate matter composition. Whereas comparably low Mn/Al-ratios are characteristic for the winter situation, maximum values are attained in late summer. This possibly reflects several microbially induced effects:

a) enhanced Mn release with higher microbial activity owing to the availability of metabolizable organic matter (spring blooms) and parallel temperature increases

b) change in particle characteristics from more mineral (clay) dominated to biogenic

c) particle transformation due to elevated radiation and parallel photo-oxidation effects.

For Fe such a relationship is not seen, presumably because the interaction with DOC is very pronounced. Despite of the reducing and sulfidic character of the tidal flats, significant dissolved and particulate Fe loads are still available in the water column. But in contrast to Mn a pore water origin of this Fe is much less likely. Therefore a terrestrial/fluvial origin of this element is indicated.

Our very preliminary results clearly demonstrate, that integrated geochemical, physical and microbiological approaches are required to fully understand this important bioreactor located at the boundary between the terrestrial and marine regime.

Imbalances in the sulfur cycle: Important players in the carbon-system?

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Previous studies of the Early Aptian (about 120 million years ago) report an increase in the ocean crust production rate and, based on carbon isotope measurements, a rapid release of gas hydrates (Larson and Erba, 1999, Hesselbo et al., 2000). Intensified volcanic CO_2-degassing related to the increase in ocean crust production rate and oxidation of methane most probably led to a rise in atmospheric CO_2-pressure and to perturbations in the carbon cycle.

The carbon and the sulfur cycle are closely linked through anaerobic degradation of organic matter by sulfate reducers. To check a possible reaction of the sulfur cycle to the perturbations in the carbon cycle we measured the sulfur and oxygen isotope composition of structurally bound sulfate in calcite from platform carbonate rocks for the equivalent time slice. Anomalously high oxygen isotope values in sulfate are indicative for diagenetic overprints and were used to exclude altered samples. The resulting data-set reflects the sulfur isotope composition of seawater sulfate. We observe a 1‰-drop in the sulfur isotope composition of seawater sulfate within a time span of about 2 million years. This change is most likely caused by an imbalance in the weathering- and burial-fluxes of sulfides (less pyrite is buried than weathered) or by an increased hydrothermal input of hydrogen sulfide.

The imbalance in the weathering- and burial-fluxes of sulfides and increased hydrothermal input of hydrogen sulfide not only affect the sulfur budget but also deliver additional H^+ to the ocean. Based on our isotope- and mass-balance calculations this additional flux reaches up to 2e12 mol H^+ per year. We conclude that this flux lowered the buffering capacities of the oceanic carbon system and hence influenced atmospheric CO_2-pressure and marine calcite oversaturation.

References

Hesselbo, S.P., Gröcke, D.R., Jenkyns, H.C., Bjerrum, C.J., Farrimond, P., Morgans-Bell, H.S. and Green, O.R., (2000). Nature 406, 392-395.

Larson, R.L. and Erba, E., (1999). Paleoceanography 14, 663-678.