

# Phosphorus Dynamics in sediments of the Darß-Zingst Bodden Chain

Do sediments provide an internal nutrient source?

F. Bitschofsky, S. Forster

## Introduction

Since the 1960s the Darß-Zingst-Bodden chain (DZBC) was subject to eutrophication impact with increased nutrient influx estimated between 200 and 300 t a<sup>-1</sup> (Selig et al., 2006). Due to the modernization and building of wastewater treatment plants, an increase of connections to treatment facilities in rural settlements, as well as restoration of canal systems the phosphorous loads were reduced since the 1980s to about 61% (Selig et al., 2006). Nevertheless the system stays in a highly productive trophic level characterised by a high phytoplankton biomass dominated by cyanobacteria and chlorophyceae (Schumann and Karsten, 2006).

In the framework of the project BACOSA (Baltic Coastal System Analysis and Status Evaluation) the phosphorous dynamics in the sediments and at the sediment-water interface were analysed to ascertain **if the sediments act as an internal nutrient source.**

Tab1: sediment parameters on two positions (0.5 and 2 m water depth) in Dabitz, means from 5 measurements during the year 2014 (March, May, July, September, November)  
LOI=Loss on Ignition, TP=total Phosphor, TC=total Carbon  
1 TP analysis only once the year on sediments from march 2014  
2 TC analysis on sediments from March and May 2014

Water depth ca. [m]	0.5	2
Median [µm]	299.4±4.3	79.9±0.2
% <63µm	2.5±1.7	34.10±1.7
water content [%]	23.9±2	75.03±4.2
LOI [% DW]	0.8±0.1	9.31±1.9
TP [mg P/g DW]	6.3±0.9*10 <sup>-5</sup>	28.5±1.4*10 <sup>-5</sup>
TC [mg C/ g DW]	2.34±0.17	36.41±7.85
mean PO <sub>4</sub> porewater flux	n.a.	29.15
mean NH <sub>4</sub> porewater flux	0.04	1051.67

## Results and Discussion

Sediments on two position with different water depth (0.5 and 2 m) in the most eastern part of the Darß-Zingst Bodden Chain (Grabow), were sampled and analysed at five points of time during the year 2014.

The two positions differ markedly in their sediment characteristics (see Tab. 1). Nevertheless both positions shows a similar total phosphorus inventory with 0.58±0.3 mol m<sup>-2</sup>. Only a very small amount of this inventory is available as soluble reactive phosphate (SRP) in the porewater. The porewater profile on the shallow water position shows constantly very low phosphate concentrations and no gradient with depth. In contrast on the 2 m position the SRP concentration increase with sediment depth (Fig. 2), supporting a diffusive outflux of approx. 30 µmol m<sup>-2</sup> d<sup>-1</sup> (Tab. 1). This is not sufficient to support an assumed primary production of 250 g C m<sup>-2</sup> yr<sup>-1</sup> (Wasmund & Schiewer, 1994) which according to Redfield (1934) account for roughly 552 µmol P m<sup>-2</sup> d<sup>-1</sup>.

The low SRP concentrations on the 0.5 m position could be explained by the P-uptake through macrophytes only growing here, as well as by a high bioturbation impact increasing the oxidised sediment surface. (Bitschofsky et al. 2015, in press).

The SRP porewater concentration depends on redox conditions in the sediment and is controlled by the adsorption-desorption equilibrium of iron-bound-phosphate (Jensen & Thamdrup 1993). This adsorption effect is shown in an experiment with phosphate enriched overlying water (Fig. 3), where the flux of phosphate is directed into the sediment

It can be concluded that **the sediment can act as source as well as sink for phosphate.** Due to the well oxidised conditions in bottom water of this shallow water estuary the phosphate fluxes out of sediment are small and can not explain the *sustained* eutrophication in this ecosystem.

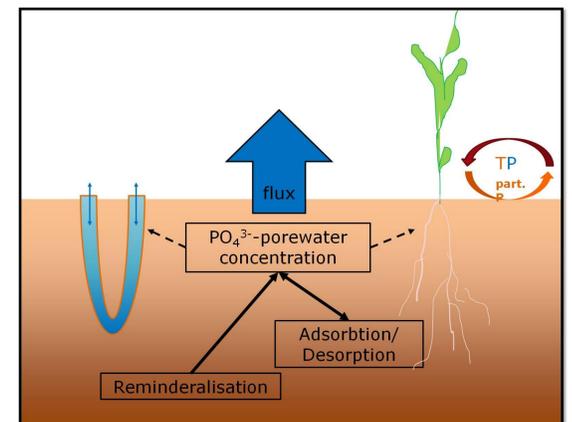


Fig. 1: scheme of different processes influencing the phosphorus dynamics in the sediment surface layer

## References

- Bitschofsky F., Forster S., Powilleit M., Gebhard C., 2015. RMB, in press  
Jensen, H., Thamdrup, B., 1993. Hydrobiologia 253, 47-59.  
Redfield, A.C., 1934. in: Daniel, R.J. (Ed.), James Johnstone Memorial Volume. University Press of Liverpool, pp. 177-192.  
Schumann, R., Baudler, H., Glass, A., Dümcke, K., Karsten, U., 2006. J. Mar. Syst. 60, 330-344.  
Selig, U., Baudler, H., Krech, M., Nausch, G., 2006. Acta Hydrochim. Hydrobiol. 34, 9-19.  
Wasmund, N., Schiewer, U., 1994. RMB 2, 41-60.

## Acknowledgment

This study is conducted within the joint research project BACOSA and supported by the BMBF framework programm "Research for Suitable Development" (FONA).

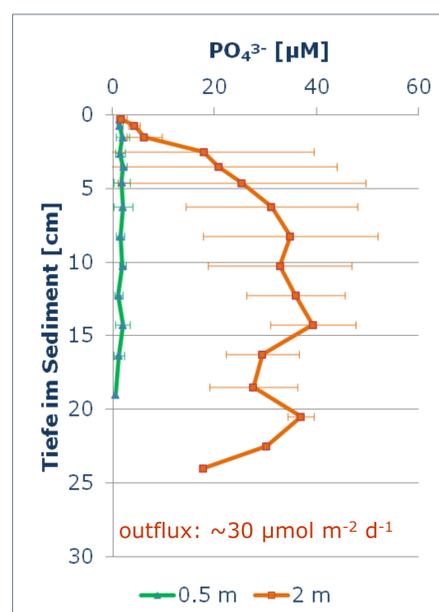


Fig. 2: mean porewater profile from four time points during 2014 on two positions at Dabitz, DZBC

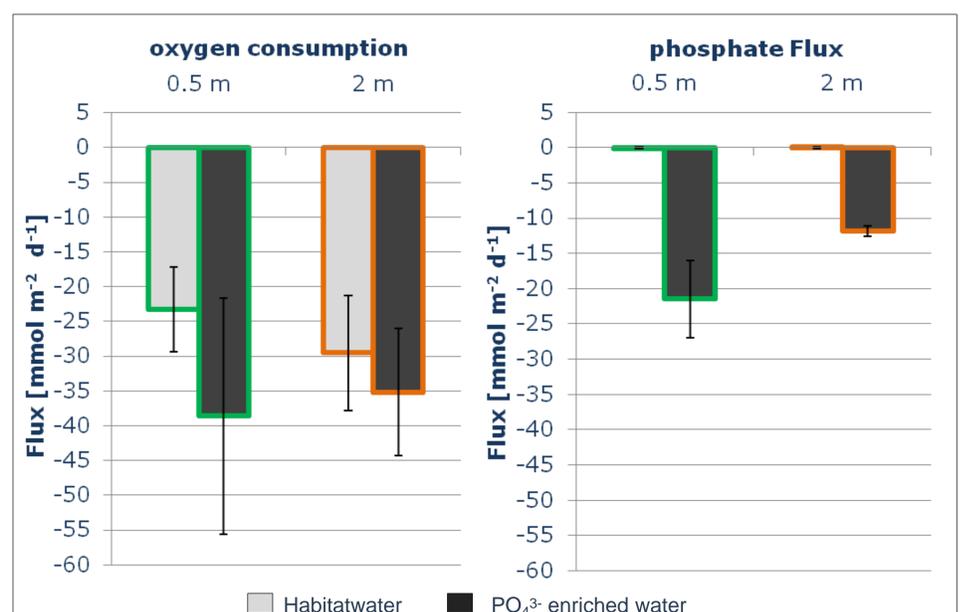


Fig. 3: oxygen consumption and phosphate flux from two incubation experiments (~5 h, 100 mm sediment cores, n=3) with different treatment of overlying water a) filtrated habitat water b) filtrated habitat water enriched with phosphate (~ 100 µM)

Contact:

Franziska Bitschofsky · University of Rostock – Institute for Bioscience – Marine Biology · Albert-Einstein Str. 3, 18059 Rostock · franziska.bitschofsky@univeristät-rostock.de