Linking increasing hypoxia to phosphorus chemistry across redox gradients in the sediment

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Background

Large areas of the deeper bottoms in the severely eutrophied Baltic Sea are hypoxic [1]. It is important to know how the major nutrients in the sediment are affected by the changing oxygen status in this brackish-water system. Phosphorus (P) is released from iron compounds under reducing conditions in the sediment and it may then further fuel algal growth. In addition, release of organic P can be enhanced under hypoxia. On the other hand, preservation and burial of carbon (C) can be more efficient under anoxia [2].

We studied the change in the chemical character of sediment P at sites along a gradient of increasing bottom-water hypoxia in the northeastern Baltic. Sediment cores were sectioned to obtain vertical profiles and the P characterization was made by sequential extraction [3]. We also investigated the changes in sediment C and nitrogen (N) and determined the dissolved nutrients at the sediment-water interface.

Discussion of Results

Concentration of dissolved P in the near-bottom water as well as sediment C and N increased towards deeper, more hypoxic basins. In our research area, organic P was most abundant in hypoxic, organic rich sediments. Enrichment of organic matter was also reflected in the pore water chemistry.

The chemical character of sediment P changed clearly along the vertical redox gradients witihin the sediment. Iron-bound P decreased strongly within the topmost 2-cm layer and the degradation of the labile organic P was most pronounced in the same section. It is likely that the reduced benthic fauna along the gradient of increasing hypoxia affected the distribution of sediment P and C.

Our results suggest that hypoxia has a significant influence on the behaviour and cycling of sediment P in the northeastern Baltic, partly through influencing the activity and the species composition of the benthic fauna.

[1] Conley *et al.* (2002) *Environ Sci Technol* **36**, 5315-5320.
[2] Ingall *et al.* (1993) *Geochim Cosmochim Acta* **57**, 303-316
[3] Jensen & Thamdrup (1993) *Hydrobiologia* **253**, 47-59.

Modern stromatolites from Lagoa Salgada, Brazil: Role of methanogens in carbonate precipitation

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Background

Stromatolites are laminated structures dating from 3.5Ga, which represent the earliest evidence of life preserved in the geological rock record. Thus, the study of their modern analogues can furnish important information concerning the microbial processes involved in ancient biomineralization. Modern trapping and binding stromatolites from Shark Bay (Western, Australia) and Highborne Cay (Bahamas) are used to interpret the environmental conditions of biogeochemical processes leading to calcification, but .these do not represent the full range of environmental conditions existing in early Earth history.

Results and Discussion

Herein, we report a preliminary molecular characterization of the microbial mat from stromatolites collected from a coastal lagoon, Lagoa Salgada, Brazil. Mat samples were analysed using microbiological and genomic techniques. The obtained genome sequences show similarities to Cyanobacteria (*Chroococcidiopsis*, *Oscillatoriale*s and *Gloeothece*), sulfur-reducing bacteria (*Desulfomicrobium*) and methanogens (*Methanobacterium* and *Methanosarcina*). The recognition of methanogenic bacteria is consistent with the $\delta^{13}C$ measurements from distinct Ca-Mg carbonate laminae. Very positive $\delta^{13}C$ values, ranging from 10 to 20 ‰ PDB, suggest methanogenic processes to be the main carbon source for the carbonate ions incorporated into the laminae. Future research will attempt to elucidate the biogeochemical processes and archaeal strains of importance in the microbial mat community, with regard to potential carbonate mineral precipitation under specific environmental conditions. The initial results demonstrating the participation of methanogens in the formation of the Lagoa Salgada stromatolites may represent what might have been an important process in the anoxic Archean environment.