Geophysical Research Abstracts, Vol. 9, 06838, 2007
SRef-ID:

Phosphorus Fractions in Sediment from a shallow Estuary to Open Sea in The Baltic Sea

K. Lukkari and M. Leivuori

Finnish Institute of Marine Research, Helsinki, Finland. email: kaarina.lukkari@fimr.fi / Phone: +358 9 613941.

Phosphorus (P) may have a key role in eutrophication in the Baltic Sea (BS). Despite decreased anthropogenic loading, high P concentrations occur in the water. It has been suggested that P partly originates from the sediments, into which it has accumulated for decades. Availability of sediment P for algae and bacteria depends on its chemical forms and prevailing conditions, especially oxygen conditions. In the BS, anoxia is common and releases iron (Fe) bound P.

Surface sediment P was characterized in a shallow estuary (the Paimionlahti Bay in the SW Finland), in the coastal sea (the Archipelago Sea, AS), and in the open BS (the Northern Baltic Proper) by fractionation. The method (Jensen and Thamdrup, 1993) separates P into six sources. Mobile (transformable) P is considered to include loosely bound and pore water P (NaCl-iP), P from hydrated oxides of reducible metals (mainly Fe; NaBD-iP), and mobile organic (or biogenic) P (NRP). Immobile P, which is supposed to act as sink for P, consists of P bound to oxides of non-reducible Fe and aluminium (Al; NaOH-iP), apatite-P (HCl-iP), and residual, mainly organic P (Res-P). Sediment samples were collected, stored, and partly extracted in nitrogen atmosphere.

Concentration of total extractable P was highest in the inner estuary and the composition of sediment P changed along the continuum. Inorganic P was most abundant in the innermost sites, while the share of organic or biogenic P dominated in the open sea. In the sediment depth profile, the immobile forms, HCl-iP, NaOH-iP, and Res-P were mainly stable. NRP and especially NaBD-iP generally decreased with sediment depth, probably as a result of degradation or reduction processes. However, relatively high NaBD-iP concentration was found in the deep layers of the estuary sediment, probably because of the high sedimentation rate and dissolution of P from sources not

reducible naturally. NaCl-iP was very small.

Areas with high concentration of Fe-bound P in the surface sediment (estuaries and the coastal sea) are the most vulnerable for internal P loading, if the conditions turn into anoxic. However, the high content of organic (biogenic) P in the AS and in the anoxic outermost site indicates that these sediments may slowly release P during degradation of organic matter, if Fe-compounds in the surface are not able to retain released P. It has been evaluated that some organic P compounds in the NRP fraction (e.g. phosphate mono- and diesters) have half-lives around 10-20 years in the sediment (Ahlgren et al. 2006). This is coincident with the decreasing NRP concentration in the sediment profile in the open sea. The organic or biogenic P sources in the sediment may partly explain the slow response of the BS to the decreasing anthropogenic P loading.

References:

Ahgren J., Tranvik, L., Gogoll, A., Waldebäck, M., Markides, K., and Rydin, E. 2005. Sediment depth attenuation of biogenic phosphorus compounds measured by 31-P NMR. Env. Sci. Techn. 39: 867-872.

Jensen, H. S. and B. Thamdrup. 1993. Iron-bound phosphorus in marine sediments as measured by bicarbonate-dithionite extraction. Hydrobiologia. 253:47-59.