HEAVY METAL FLUXES TO TWO BALTIC RIVER RECIPIENTS: SEDIMENT STUDIES IN THE GULF OF RIGA AND THE CURONIAN LAGOON.

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The objectives of the Nordic Environmental Research Programme "The Gulf of Riga Project 1994-1997" are to provide the data and the understanding of the processes for an overall description as a system model of the Gulf of Riga - a embayment to the Central Baltic Sea between Estonia and Latvia. Further to promote co-operation between scientists in the Scandinavia and the "new" Baltic republics. The project embraces such subjects as oceanography, pelagic and benthic biological processes, processes in the drainage basin and discharge to the Sea, nearshore-basin exchanges and evaluation of the state of pollution. This presentation focus on the results of the studies of the role of the bottom sediments and sedimentation processes for the spatial distribution from the river to the seafloor and the vertical distribution in the seafloor of nutrients and inorganic pollutants such as selected heavy metal (e.g. Hg, Cd, Pb, Cu). A quantitative understanding of the sedimentation (a sediment budget) as well as estimates of overall massbalances for selected substances has been established, as a contribution to the general system models. For comparison data from the Lithuanian Namunas River/Curonian Lagoon has been compiled.
The basic techniques are to combine marine geological mapping of sedimentary environments (erosion, depositional areas etc.), measurements of regional sedimentation rate based on geophysical data and knowledge of the geological history of the area supported with measurements of local mixing rates and sedimentation rates by Pb210 and Cs137 profiles and with results of sediment monitoring data.
The stable brackish Gulf of Riga is the recipient for River Daugava (A=87.900 km^2, Q = 688 m^3s^{-1}). The almost fresh Kursiu Mares (Curonian Lagoon) is the recipient of the Nemunas River (A = 98.200 km^2, Q = 674 m^3s^{-1}). Both are significant outlets to the Baltic Sea from the Baltic countries.
The Gulf of Riga is comparatively deep, 30-40 m, and almost only the near shore areas are under strong wave influence. The difference between surface and bottom salinity is small, so stratification in the water column is mostly due to the annual temperature cycle. Total mixing occurs, and even the deep seafloor are oxic in the surface layer. Marked variations through the seasons in the metal content in the surface layer has been observed within

the wave influenced zone, probably due to ephemeral deposition of sediment with a more or less organic/fine grained admixture. A characteristic feature are the extensive areas in water depths 10-30 m with early Holocene (older than 8000 years) sediments almost in the seafloor, which proves no net deposition. Net erosion is often indicated by cut layers seen in sediment-echosounding profiles. However, a few cm thick layer of muddy sediments, with metal concentrations comparable to the ones in depositional areas suggests, that an ephemeral sedimentation takes place. For the small benthic organisms are the "sediment load" differences between the two environments slight. Fe-Mn nodules are wide spread in the non-deposit areas. Besides the muddy sediment they provide an additional collector of metals and substrates for the epifauna, but otherwise their ecological influence are unclear.

Recent mud accumulation areas cover about 30% of the area of the Gulf. Bioturbation is often low in the accumulation bottoms because the benthic macrofauna in the mud is so impoverished by the brackish water. This combined with locally very high accumulation rates (500-1500 g dry matter m^2/yr. as estimated by Pb210 and Cs137 profiles) of muddy sediment offer excellent condition for recording of the net flux to the seafloor of heavy metals through time (an example is given in Figure1) and base for assessments of the seafloor as sink for metals and nutrients. It is estimated that about 1.3 10^6 t dry matter are deposited annually in the mudareas, coastal sand deposits are not included. Based on work in progress (May 1997) the latest assessment for the sediment sink will be presented at the meeting.

The Numunas (Neman) River debauches into the very shallow (average 4 m deep Coronian Lagoon). This is separated from the Baltic Sea by a barrier sandspit but from a narrow outlet at the town Klaipeda. The water in the Lagoon is mostly fresh - except near the outlet with variable estuarine conditions. Due to the shallow depths are the water masses very well mixed. Judged by the Pb210 and the Chernobyl Cs137 also the topmost 10-20 cm of mud sediments are frequently disturbed.

The sediments in the sedimentation areas of the lagoon, seem not to contain a readable detailed record of the pollution history of the Lagoon. It is hoped that an planned investigation of sediments deposited in meadows by nearly annual floodings may be promising. Sediment budgets mostly based on measurements of concentrations and composition suspended material and waterexchange suggests that 1.3-3,4 10^5 t dry-sediment of which 5-15 % is organic, are deposited annually in the lagoon. This correspond to ca 80- 200 g/m^2/yr. over the whole area or roughly the double if only areas with mud accumulation are considered. This accumulationrate of the same magnitude as calculated in the Gulf of Riga. However the loss to the open Baltic of sediment material and especially suspended organic matter seems to be much higher from the Lagoon than the Gulf of Riga, in spite of the almost equivalent river input.

Based on work in progress, modelling of the response of the two environments on changes in fluxes of pollutants and their interaction with the open Baltic will be compared.

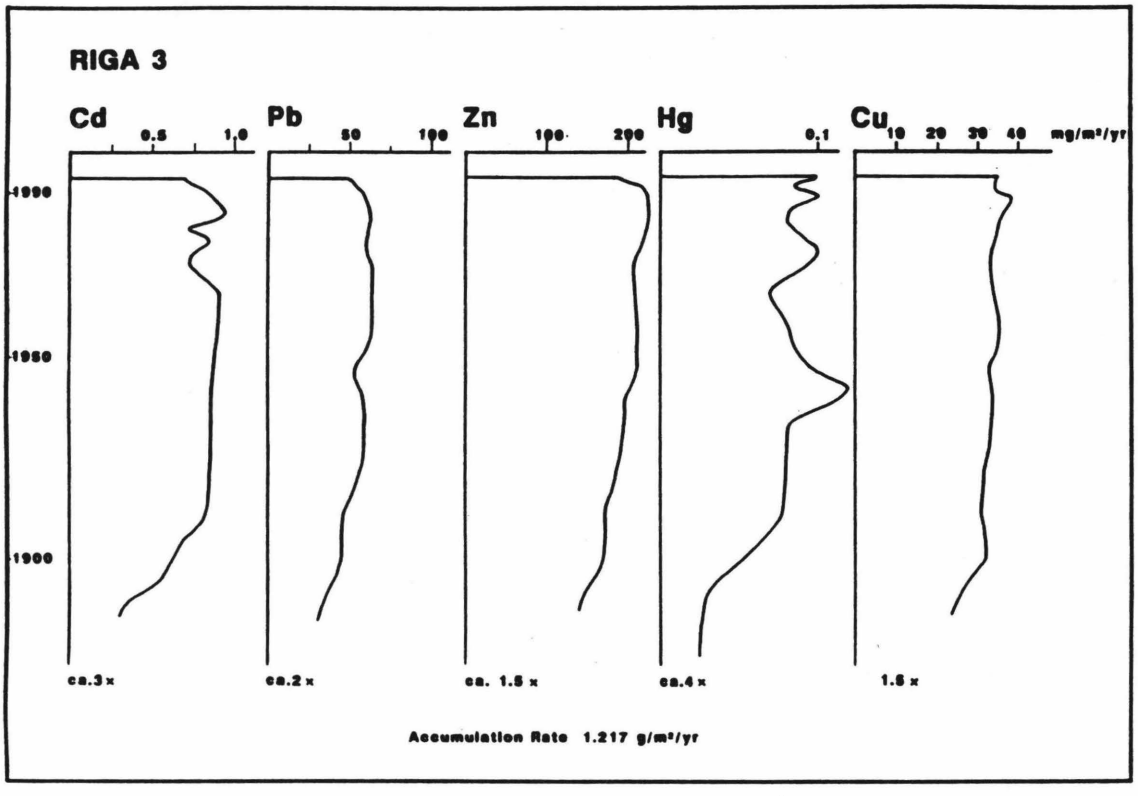

Fig. 1. Accumulation rates in mg/m^2/gr. of Cd, Pb, Zn, Hg & Cu through time calculated from concentrations and mean accumulation rate of dry matter determined from the Pb210 profile. Riga 3 is situated in the Ruhnu Deep in the central Gulf of Riga.