Geochemical properties of sediments in the Scheldt estuary with emphasis on trace metals

Mohamed Bouezmarni and Roland Wollast
Université Libre de Bruxelles, Laboratory of Chemical Oceanography

Surficial sediment of the Scheldt estuary were collected with a Van Veen grab at 57 stations between Temse and Vlissingen. They were analyzed for major elements (Si, Al, Fe, Ca, Mg, Na, K, Corg, Cinorg, Norg and P) and trace metals (Mn, Cr, Ni, Co, Zn, Cu, Cd, Pb, Li). Factor analysis indicates that 44% of the variance can be explained by one factor which exhibits a high saturation for trace metals, organic matter, Al and Fe, all variables typical of fine muds. The high scores of this first factor are almost exclusively present in the upper estuary except for one area in front of Terneuzen. The second factor which explains 23% of the variance is typical of the carbonates and the third one (19% of the variance) is representative of the clay minerals. These two factors are more evenly distributed over the estuary.

As usual, there is a strong influence of granulometry on the distribution of elements in the sediments. Intercomparaison of their composition within the Scheldt or with other aquatic systems require thus a normalization procedure. This problem has been studied in detail by analysing various size fractions (63-16:; 16-8:; 8-4:;<4:) separated by elutriation or by using a typical parameter of the fine fraction such as the specific surface area of the samples or the concentration of a selected element (Al, Fe, Li, Corg). The normalization of trace metals allowed us to evaluate an enrichment factor of the trace elements in the estuarine deposits due to man's activities. In addition, it allows also to demonstrate the marked decrease of the anthropogenic impact by comparing the composition of sediments collected in 1976 and in 1994.

Finally, we have developed a new method based on the titration of the suspended sediment with HCl, which allows to gain information on the speciation and potential reactivity of trace metals. This method indicates the Zn and Cd are associated with sulfides and are rather reactive. Copper is released together with Al indicating a possible link of this element with clay mineral whereas Pb and Cr are redissolved together with Fe. The dissolution curve also indicates that Mn is present as rhodochrosite in the easily dissolving carbonate phase and as oxy-hydroxide in the more refractory phase. Mn is strongly correlated to Co.