

Influence of major elements and geological substrate on heavy metal composition of river sediments

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Abstract

Organic matter and clay content are generally used as predicting variables for background values of heavy metals in soils and sediments. For example, in environmental legislation, a standardization of total concentrations of heavy metals and organic pollutants is performed based on the clay- and organic carbon content and pH(KCl) of soils and sediments. In the present study, the relationship between total concentrations of heavy metals, major elements, the location and/or geological substrate of 105 river sediments in Flanders was investigated. Besides total element concentrations (As, Cd, Cr, Cu, Hg, Pb, Ni, Sn, Zn, Ca, Mg, Fe, Mn, Na, K, Mg, N, P), clay content, organic matter content and pH were determined. A statistical analysis of the dataset was performed with SPSS 16.0 for Windows.

There was a significant difference between different river basins with regard to the clay content of the sediments. In general, the clay content increased from east to west, in accordance with changes in the geological substratum. Strong positive correlations were observed between the heavy metals Cu, Cr, Hg, Ni and Pb and between As, Cr and Fe. Total concentrations of Mg, Na, K en Ca were positively correlated with the clay content of the sediments.

Principal Component Analysis was used to divide the dataset into four components: a lithogenic component (including clay organic matter, Na, Ca, Ca, Mg), a relationship between Fe, As and Cd, an anthropogenic factor (including Cu, Hg, Pb, Sn and Zn) and the insoluble residue. Multiple linear regressions showed that, besides clay and organic matter content, total concentrations of Fe and Ca are also important variables that can explain total concentrations of heavy metals in the sediments. Further research should establish whether these elements should be taken into account for the standardization of total metal concentrations in soils and sediments and whether additional parameters should be considered in environmental legislation concerning contaminated soils and sediments.