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Heavy metal contamination in sediments of an open drainage system due to urban emissions

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The sediments of an artificial trench used as an open drainage system in the urban area of the city of Darmstadt were investigated. The drainage system (several hand dig trenches) was constructed in historical time periods in order to drain wetlands. With increasing industrialisation the trenches were used as wastewater drainage system, leading to a contamination of the sediments with various pollutants, such as heavy metals (HM). The concentration, horizontal and vertical distribution of the HMs Zn, Ni, Cu, Pb and Cd in several sediment cores were investigated. Complete sediment cores were obtained from a lined driller. The samples were sieved and separated in several grain sizes. With a sequential extraction of the HMs the mobility and distribution were analysed. The heavy metal concentration followed in all samples the order Zn >> Ni > Cu > Pb > Cd. Grain size dependent differences in the HM concentrations could be found in the fraction <0,063mm. For each HM a specific distribution in the various sediment phases was investigated. Pb is fixed in the residual phase. Cd is usually bound to the carbonate phase, but could be found in small portions in the residual as well as the cation exchange phase. Cooper is linked to organic and sulphuric phases, whereas Zn is usually bound to carbonate and reductive phase. Ni can be found in the residual phase, but was also present in the reductive, organic and sulphuric phase. The HM concentration in the pore water was below legislative water limits for Pb, Cd and Ni, but was exceeding the limits for Cu and Zn. Chemical models show, that Cu and Zn bound in sediments are becoming mobile with increasing redox potential, due to better surface water quality (all industrial sites are now using the urban sewer system). The concentration of Pb, Cu and Ni in the trench water is well below legislative water limits. Only for Zn an increased water concentration was found, which might be due to sporadic input from metal industries.