Heavy metal concentrations, distributions and mobilities in wetland soils

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As part of an interdisciplinary project on Development of a Generalised Robust Indication System for Ecological Changes in Riverside Wetlands (RIVA) the UFZ Department of Soil Sciences investigated concentrations, distributions and mobilities of heavy metals in selected wetland soils at the river Elbe near the village of Steckby and north-west of Dessau, near Woerlitz. The sites are described in detail by Rinklebe et al. (1999 a,b). Further field studies and process investigations in laboratory systems will serve to elucidate the fate of carbon, nutrients and pollutants in wetlands and integrate those data into above mentioned indication system. Therefore we investigated soil samples down to 2 m of 15 soil profiles. The samples were collected according to different soil horizons.

The heavy metal concentrations of most soil samples at both riverine systems exceed the critical limits set by the German soil conservation law (BBodSchV 1999). Concentrations were generally higher in clayey and loamy than in sandy soil layers and followed the fluvial sedimentation (Fig. 1, 2). Partly we found extremely high concentrations of heavy metals in soils. So we measured concentrations of zinc up to 1.000 ppm, of lead up to 230 ppm, of chrome up to 180 ppm, of copper up to 170 ppm, of arsenic up to 112 ppm, of nickel up to 60 ppm, of cadmium up to 7 ppm and of mercury up to 5 ppm.

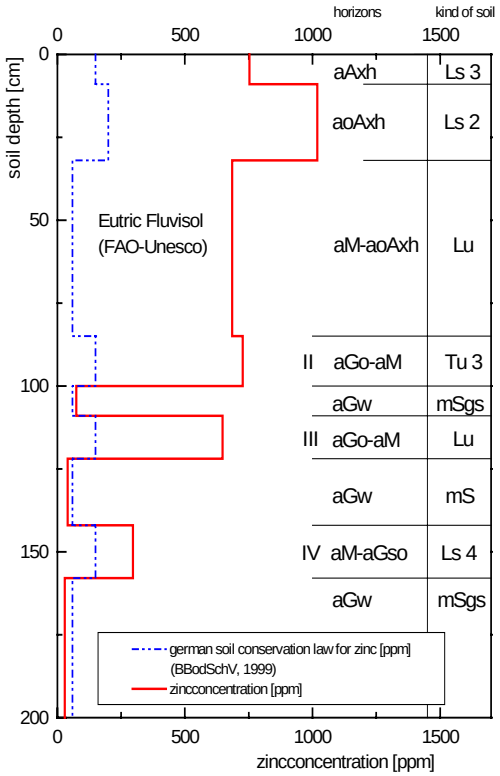

Fig. 1. Zinc concentration of an Eutric Fluvisol

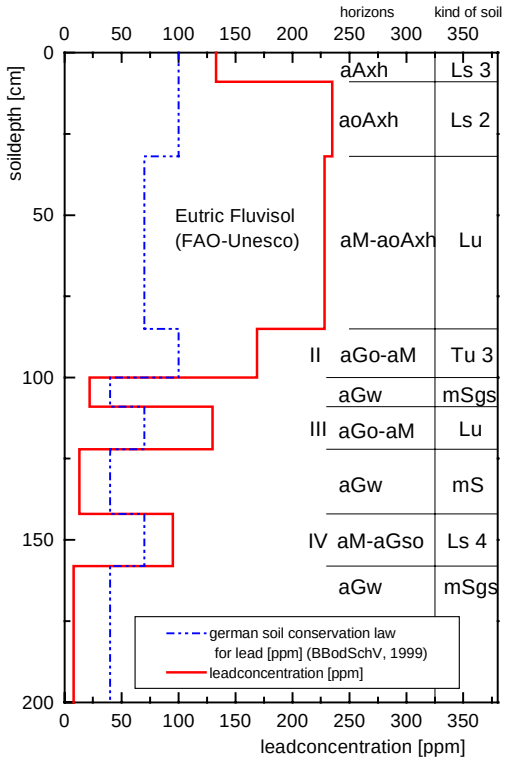

Fig. 2. Lead concentration of an Eutric Fluvisol

Heavy metal concentrations correlated significantly with organic carbon (C_{org}), clay, iron, manganese contents, effective cation exchange capacity (CEC_{eff}) and with electric conductivity (cond.) (Tab. 1).

Tab. 1. Correlation coefficient of element concentrations with soil properties in 98 wetland soils

	C_{org}	clay	CEC_{eff}	cond.	Cr (RFA)	Cu (RFA)	Fe (total)	Mn (total)	Ni (RFA)	Pb (RFA)	Zn (RFA)
C_{org}	1,00										
clay	0,46**	1,00									
CEC_{eff}	0,54**	0,58**	1,00								
cond.	0,55**	0,50**	0,44**	1,00							
Cr (RFA)	0,84**	0,54**	0,70**	0,50**	1,00						
Cu (RFA)	0,88**	0,53**	0,57**	0,50**	0,72**	1,00					
Fe (total)	0,44**	0,64**	0,77**	0,41**	0,65**	0,71**	1,00				
Mn (total)	0,30**	0,34**	0,53**	0,53*	0,46**	0,52**	0,57**	1,00			
Ni (RFA)	0,58**	0,66**	0,63**	0,63**	0,63**	0,82**	0,65**	0,41**	1,00		
Pb (RFA)	0,70**	0,46**	0,54**	0,52**	0,68**	0,93**	0,49**	0,35**	0,59**	1,00	
Zn (RFA)	0,70**	0,46**	0,60**	0,47**	0,68**	0,91**	0,55**	0,62**	0,62**	0,84**	1,00

Significant at levels of α =* 0,05 and ** 0,01 respectively.
(Spearman-Rho, non-parametric test); n = 98

Mobile fractions of heavy metals extracted with distilled water or with water of the Elbe-River were very low (<1%). NH_4NO_3 - extracts yielded higher concentrations of mobile heavy metals. The hot-water extractable carbonfraction (C_{HWE}) correlated significantly with the NH_4NO_3 - extractable zincfraction (Fig. 3).

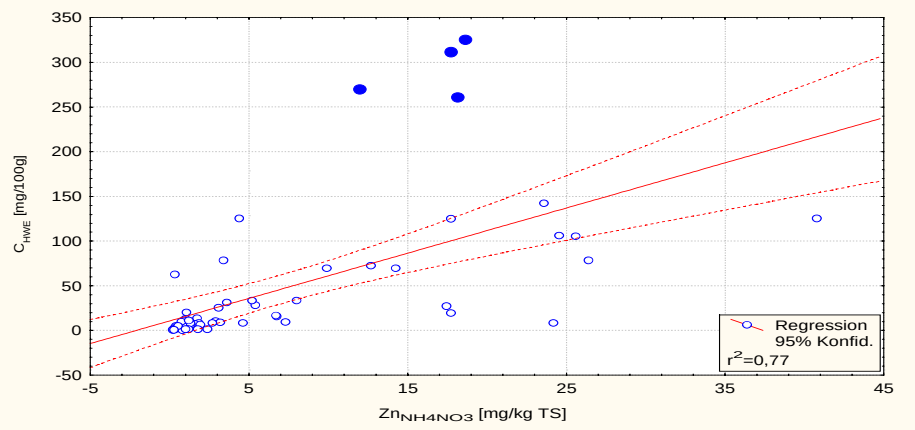

Fig. 3. Correlations between easy decomposable carbonfraction (C_{HWE}) and mobile (NH_4NO_3 -extractable) zincfraction. The marked points are the very top soils rich in organic matter from long flooded depressions, excluding these outliers r^2=0,85

References

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