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Dissolved Metals in a Floodplain Soil: Comparison of Soil Solution, Extract and Soil Column Experiment Data

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Due to industrial and agricultural activities of mankind, soils may be contaminated with toxic metals, e.g., floodplain soils subjected to periodical flooding events. Knowledge on contaminant concentrations and release processes are necessary to estimate possible contaminant export, but it is laborious to obtain the soil solution *in situ*. Therefore, we carried out two soil extraction methods (soil saturation extracts (SSE) and so-called S 4 extractions with a soil:solution ratio of 1:10) and soil column experiments with a mineral horizon of a Mollic Fluvisol located at the Elbe River, Germany, for which the soil solution was gained with ceramic suction cups for a period of three years. We conducted column experiments applying two different flow velocities and four flow interruptions of different duration (4 h to 21 d). The eluates were analysed for contents of metals and pH. The breakthrough curves were inversely modelled by fitting the Zn and Ni data to the advection-dispersion equation by using the numerical code RICHY considering rate-limited desorption. Several physical and chemical soil properties were determined including sequential metal extraction, total element contents, soil texture, C and pH. High contents of metals or metalloids such as Zn, Cd, As and Pb were detected, e.g., Zn, 1180 mg kg^{-1}. The substrate was neutral (pH 5.7) and contained 5.3 g C kg^{-1}. Results of sequential extraction suggest that metals are potentially mobilised in large quantities, e.g., 20 % of total Zn. Soil solution concentrations of Zn varied between 1.1 and 9.2 mg l^{-1}, those of Ni between 4 and 328

μg l^{-1}. The column experiments indicated rate-limited release of Ni and Zn due to effects of the flow velocities and the flow interruptions with increased concentrations after restoring the flow, whereas As and Pb showed diffuse release patterns. Release of Zn and Ni was very slow (k appr. 10^{-4} min^{-1}). Amounts of releasable adsorbed Zn and Ni are very similar to those of the SSE. Results from SSE showed much higher Zn- and Ni-concentrations than in soil solution. More Zn and Ni are present in the soil solution than determined in S 4 extractions as well as in soil column eluates due to redox reactions, adsorption/desorption processes and various factors under field conditions. The kinetics of metal release was successfully qualified and quantified by soil column experiments and modelling. However, the low metal concentrations detected indicate that the release was limited to leaching of the most labile metal fraction under the current experimental conditions.