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Release of organic matter and organic contaminants from floodplain soils under variable redox conditions: influenced by organo-mineral complexes?

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Ongoing flood events may enhance the release and transport of contaminants accumulated in floodplain soils. In this context the effect of mobile particles on contaminant transport is quite well understood from the physicochemical point of view, little is known on the role of variable redox conditions on the fate of mobile sorbents and facilitated transport under natural conditions.

We explored the effect of extended flood events on the release and export of contaminants and colloidal material as well as organic substances in an alluvial soil. Lasting flood events resulted in water-saturated conditions and a reduced additional supply of oxygen. We hypothesized that these conditions favor the release of organic and inorganic contaminants. Microbial activities intensify the initialized anaerobic conditions, which resulted in a reductive dissolution of oxides and organic matter and such to the release of the contaminants in interaction with organo-mineral complexes.

To elucidate the processes which control formation, release, transport and immobilisation under variable redox conditions, we ran column experiments under water saturated conditions and simulated ongoing flood events while have flow interruption of certain periods of time. The effluent was collected and analyzed. Analysis comprised **t**otal and **d**issolved **o**rganic **c**arbon (TOC and DOC), turbidity, major anions and cations, redox potential, CO_2 concentration, pH, polycyclic aromatic hydrocarbons (Σ PAHs: Acenaphtene, Phenanthrene, Anthracene, Pyrene, Fluoranthene, B(a,k)fluoranthene, B(a)pyrene and B(g,h,i)perylene) and selected heavy metals.

Under prolonged water saturated conditions and decreased redox conditions we find

increasing concentrations of mobile sorbents and a increase of contaminant effluxes. For instance we detect a huge decrease of redox potential (from 200 mV to -5 mV) and a steep increase in the CO_2 (from18 mg l^{-1} to approx. 150 mg l^{-1}) concentration during a flow interruption of 720 h while we reach turbidity values from 6 to 1336 FAU (formazine attenuation units). We observe the onset of the reduction of Fe (As) and Mn oxides and the export of dissolved iron, arsenic and manganese from the columns in consequence of the loss of aqueous terminal electron acceptors like dissolved oxygen, nitrate or sulphate. Together with these substances the export of turbidity, DOC, mobile sorbents and inorganic and organic contaminants increase. We identify possible sorbents like DOC, TOC, iron oxides and arsenic. Although the results show that there are a high affinity between the release of DOM and the PAHs, we assume that the PAHs transport is not only initialized on the release of organic matter. We have to take the colloidal transport of iron and manganese and more over the transport via organo-mineral complexes into account.

Seasonal flood events of river bank and floodplain soils will cause lower redox potentials. Among others, such temporal redox gradients are one necessary precondition for the formation and mobilization of colloidal and suspended materials and pose a potential risk for river and groundwater quality.