Geophysical Research Abstracts, Vol. 9, 03488, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03488

The influence of stream-groundwater interactions on the spatial distribution of organic contaminants in the streambed

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Flow dynamics and geochemical conditions in the streambed are potentially very complex. We investigated a man-made channel which drained the untreated wastewater of a chemical industry site for decades. Along the investigated reach, a variety of contaminants, mainly monochlorobenzene, dichlorobenzenes, trichlorobenzenes, and hexachlorocyclohexanes, can be found in the surface water, the groundwater, and in the streambed sediments. We hypothesized that the organic carbon-rich streambed sediments act as a long-term storage zone for contaminants and that these contaminants are currently released back to the stream. Moreover, the actual distribution of contaminants in the streambed may strongly depend on the flow dynamics at the stream-groundwater interface.

In our approach, we first quantified the water fluxes through the streambed along a reach of 280m length with fine spatial resolution using streambed temperature mapping. The resulting water fluxes ranged between -10.0 and 455.0 $Lm^{-2}d^{-1}$. The spatial patterns were characterized by distinct high groundwater discharge locations and significant portions of very low groundwater discharge with potential hyporheic exchange fluxes. Then, according to the temperature patterns, we investigated contaminant concentrations in the streambed at the high groundwater discharge zones and the zones with potential hyporheic exchange flows. The horizontal and vertical contaminant distribution at the sampling locations was examined using snapshot sampling of streambed sediments and time-integrating passive sampling of the interstitial pore water. The concentrations and occurrence of different contaminants varied significantly between groundwater discharge locations and locations with potential hyporheic ex-

change flows. High groundwater discharge locations are characterized by lower and vertically homogeneously distributed contaminant concentrations. Locations with potential hyporheic exchange show higher contaminant concentration with a high variance.

Spatial patterns of stream-groundwater interactions have essential effects on the distribution of contaminants in the streambed. For a successful evaluation of retention and degradation processes in the streambed, it is always crucial to consider the interfacial flow dynamics.