Geophysical Research Abstracts
Vol. 20, EGU2018-16679, 2018
EGU General Assembly 2018

Evaluation of the retention of organic pollutants in urban swale-trench systems by fluorescent tracers

Marcus Bork (1), Jens Lange (2), Markus Graf-Rosenfellner (1), Birte Hensen (3), Oliver Olsson (3), and Friederike Lang (1)

(1) University of Freiburg, Chair of Soil Ecology, Freiburg i.Br., Germany (marcus.bork@bodenkunde.uni-freiburg.de), (2) University of Freiburg, Chair of Hydrology, Freiburg i.Br., Germany (jens.lange@hydrology.uni-freiburg.de), (3) Leuphana University, Institute of Sustainable and Environmental Chemistry, Lüneburg, Germany (oliver.olsson@leuphana.de)

Urban stromwater infiltration through swale-trench systems into groundwater increases urban groundwater recharge and hence reduces negative effects of urbanisation on the water balance. At the same time, this measure may endanger groundwater quality. Amongst other uses, biocides are applied to supress algae and fungi growth on roofs or facades and are leached into urban stormwater during heavy rainfall. The retention of biocides in swale-trench systems depends for example on the physicochemical properties of the pollutants, on the particle size distribution of the soil or filling material and on the vegetation cover. These properties of the swale-trench system can change with time. Thus, we hypothesise that the mobility of pollutants is closely related to the age of the swale-trench system. Therefore, we compared the ability of three individual swale-trench systems in Freiburg, Germany (A, 2 years, W, 23 years, V, 26 years) to retain organic substances by the use of fluorescent tracers and various biocides in a column-experiment.

We extracted one undisturbed soil core using a stainless steel soil column (diameter: 20 cm, depth: 25 cm) from every system. The column experiment was conducted under nearly saturated conditions. We worked with a small supernatant at the upper boundary (approx. 2 cm) and a pendulous water column of 45 cm at the lower boundary. The substance solution was applied continuously for 26 - 32 hours and contained the tracers bromide (50 mg/L), uranine (UR, 10 μg/L) and sulforhodamine B (SRB, 400 μg/L); the biocides diuron, terbutryn and octhilinone (50 μg/L each); and the transformation products metazachlor-ESA and metazachlor-OA (10 μg/L each). The flow rates ranged between 0.5 and 3.5 cm/h due to slightly different soil properties.

The quickest breakthrough of all tracers happened in the column of system V where even the most sorptive tracers (SRB and UR) were only slightly retained. By contrast, the column from system A showed a delayed breakthrough of bromide, while UR and SRB were distinctly retained (approximately by 50 % and 80 %) suggesting a more intense contact to the soil matrix. Additionally, first results indicate that biocides and transformation products also break through all soil columns but with a broad range of retention. These results can be explained by an increasing number of preferential flow paths (A < W < V) which was also shown by staining the soil cores with the dye Brilliant Blue after the column experiment was completed. The number of preferential flow paths was significantly related to the age of the swale-trench system: the older the system the higher the number of preferential flow paths. In the oldest system, most macropores were present, likely related to biological activity, especially of earthworms. Hence, the retention in this swale-trench system was lowest.

Thus, our results indicate that the risk of biocides break through and therefore groundwater pollution increases with increasing age of swale-trench systems, especially if preferential flow paths are present and biocide mobility is controlled by adsorption processes.

This study was perfomed in the framework of the BMBF MUTReWa-project (www.mutrewa.de).