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Assessment of riverbank filtration using selected organic micropollutants

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Managed riverbank filtration (MRBF) is frequently used as a (pre)treatment step to improve surface water quality for drinking water use. In a managed RBF systems the understanding of flow patterns, mixing processes and groundwater residence times is a key factor to assess the effectiveness of the natural attenuation processes and to secure a good water quality.

This study evaluates a suite of organic micropollutants (selected artificial sweeteners, pharmaceuticals and the MRI contrast agent gadolinium) as tracers for river water infiltration into a glaciofluvial aquifer. In particular, the transport behaviour of the selected micropollutants and their suitability to estimate groundwater residence times at a small scale (< 100 m) are assessed.

The investigated MRBF system is located in a sub-alpine river valley in a rural catchment and the river permanently infiltrates into the aquifer. The aquifer consists of coarse carbonaceous gravel and is characterized by high permeabilities and groundwater flow velocities. The aquifer thickness reaches values of 16m with a saturated thickness of approximately 6m.

The field site was instrumented with ten rhizons (Rhizosphere® microfiltration membrane pore water samplers) along a transect in groundwater flow direction to allow for a high spatial and temporal monitoring resolution. The rhizons were installed beneath the river bed and in the aquifer at different depths (7-13 m) and at different distances (20-60 m) to the river. The selected micropollutants were monitored over a period of ten days, water samples were collected as 12h composite samples. In addition to the selected micropollutants also conventional hydrochemical data and stable water isotopes were analyzed. Radon (^{222}Rn) was used as a natural occurring tracer to determine groundwater ages.

Based on ^{222}Rn measurement the residence times were estimated to be below seven days in the transect. Hydrochemical data indicates that groundwater is recharged exclusively by river water infiltration at all depths and that mixing with ambient groundwater is negligible. To assess the suitability of the proposed tracers to estimate groundwater travel times the temporal variability of these compounds in the stream and the groundwater were analyzed.