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Chemical Source Tracking of Bacterial Contamination Using Micropollutants – A Karst Aquifer Case Study

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Karst aquifers are important drinking water resources in many parts of the world, though they are well known for their high vulnerability to contamination. Rainfall and snowmelt often trigger temporary contamination of karst water resources. Free-range animal breeding and application of manure on the one hand and sewage leakage or spillage on the other hand are usually regarded as main sources for fecal contamination. But distinction of their respective contributions is difficult. This study investigates the feasibility to track the origin of fecal contamination from the occurrences of indicator bacteria and chemical source indicators in karst spring water.

The study site is the 45 km^2 rural catchment of the perennial karst spring Gallusquelle in SW-Germany (mean discharge: 0.5 m^3/s). Overflow events of a stormwater detention basin (combined sewer system) are known to impact water quality at the spring. There is no free-range animal breeding in the catchment but intense application of manure.

Following two heavy rainfall events with overflow of the stormwater detention basin, spring water was sampled over several days. Samples were analysed for indicator bacteria (total Coliform, E. coli, Enterococci) and 57 micropollutants, among them cyclamate and metazachlor. For the Gallusquelle catchment the artificial sweetener cyclamate and the herbicide metazachlor have been established as source specific indicators, the former for the sewer system and the latter for cropland.

Though recharge in the Gallusquelle catchment is predominantly diffuse, there is a significant portion of direct recharge reflected by distinct breakthrough curves for cyclamate and metazachlor. The breakthrough of indicator bacteria coincides very well with the occurrence of both, cyclamate and metazachlor. However, indicator bacteria cannot be unambiguously tracked back to a specific source.