



Organic micro-pollutants in a karst system during low and high flow periods, results of a two-year study

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Fifty-four different organic micro-pollutants (OMPs) including pharmaceuticals, pesticides, corrosion inhibitors and other typical wastewater compounds such as caffeine are repeatedly analyzed in approximately fifty groundwater observation points in a complex faulted and fractured carbonate aquifer system consisting of three main spring catchment areas. The study area is characterized as well by the influence of an urban area with industrial sites and waste disposals as by surrounding agricultural uses.

With the applied HPLC-MS/MS method (Nödler et al., 2010), achieving method quantification limits (MQL) of 1.8 – 28 ng L-1, forty-four of the OMPs are detected in groundwater. Indicating a subsurface water divide, OMPs distinguish between the North and the South main spring areas with respect to the number of detected OMPs, OMP combinations, occurrence of special compounds like tamoxifen and concentrations of triazoles and triazines. Regarding the vertical distribution in the aquifer system upper aquifers exhibit a higher number and higher seasonal variety of OMPs than the lower aquifer and the main spring areas.

In addition to triazines and triazoles the anti-epileptic drug carbamazepine and the analgesic drug phenazone are the most frequently detected compounds. The detection of the estrogen antagonist tamoxifen in a groundwater flow system is reported for the first time. Defined combinations of OMPs occur repeatedly in the same observation wells and allow to distinguish different input functions. The comparison of detection frequency with the number of prescribed doses gives information about the specific persistence of pharmaceuticals.

A disused waste disposal is identified as input area for triazines. Additional input of triazines in the agricultural areas may be indicated by different fractions of atrazine and its degradation products. Due to prohibition of atrazine as herbicide since 1992 the occurrence of OMPs in the lower aquifer, solely limited to atrazine and desethylatrazine, indicates limited aquifer connections and demonstrates a residence time of several years for vertical transport into the deep aquifer. Phenazone originates also from a disused waste disposal and is showing a persistency for more than three decades under the observed redox conditions.

References

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