Occurrence of pharmaceutical compounds in natural springs

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Environmental Framework

Pharmaceutical compounds occur in groundwater because of organic fertilization or the impact of human sources. Their fate in the subsurface is governed by hydrogeological and geochemical processes, which depend on the aquifer nature and the compound behaviour along the flow path.

Natural springs stand as undisturbed locations where flow paths bring information about the transport of these emerging contaminants, according to the nearby land use. Natural springs are also surrogate sampling points that characterize the pollution levels that will otherwise reach the water table and the whole groundwater system [1].

Goals and Methods

Ten natural springs were sampled in three distinct campaigns to characterize the occurrence of pharmaceuticals, a priori from agricultural origin, under distinct hydro-geological settings and their seasonality. Our aim is to gather evidence of the processes that control their fate in the earlier stages of infiltration that will later on affect small watercourses as well as aquifer recharge. Spring water was collected and analysed for hydro-chemical, isotopic, and pharmaceutical compound concentrations. Antibiotic gene resistance was also considered as a response of the groundwater microbiome to potential antibiotics.

Results and Discussion

All sampled natural springs presented agricultural influence as pointed out by nitrate concentrations usually larger than 100 mg/L. Identified pharmaceuticals are tetracycline, doxycycline, chlortetracycline, oxytetracycline, clindamycin, sulfamethoxazole and sulfamethazine, while other analysed pharmaceuticals (25) remained non-detected. Seasonal sampling indicates a large variability of occurrences and concentrations. These results indicate the difficulties to forecast emerging contaminant input concentrations derived from diffuse sources to streams and groundwater. [Funded by project CGL2017-87216-C4-4-R].

[1] Boy et al. (2013). *Sci. Total Environ*. **452-453**: 433-445.