Protection of peri-urban groundwater catchments: a multi-tracer approach for the identification of urban pollution sources

Laura Balzani, Philippe Orban, and Serge Brouyère
University of Liège, Urban & Environmental Engineering Research Unit (UEE) GEO³ - Hydrogeology and Environmental Geology, Department of Architecture, Geology, Environment & Constructions, Liège, Belgium (laura.balzani@uliege.be)

Groundwater catchment located in peri-urban areas may be impacted by many pollutants coming from different types of point or diffuse sources such as accidental spills, continuous hidden leaks in drainage networks, old landfills, treated/untreated wastewater and watercourses.

In the scope of the CASPER project, a new methodological approach has been developed based on field survey and interpretation of the collected data in order to distinguish between the different sources of contamination and mixtures of pollutants. First, the groundwater catchment area corresponding to the land surface perimeter in which abstracted groundwater is recharged is determined and characterised in hydrogeological terms. The possible sources of pollution are identified. In a second step, a groundwater and surface water monitoring survey is established, and water samples are collected focusing on a combination of physicochemical parameters and set of various hydrochemical indicators. In particular, different stable isotopes are considered. The NO₃⁻ and B stable isotopes are used to distinguish between inputs linked to urban effluents, agricultural fertilisers and manure. Stable isotopes of SO₄²⁻ are used to distinguish between sulphide minerals oxidation, sulphur-carbon compounds mineralisation, lixiviation and human pollution. Moreover, the occurrence of specific molecules like pharmaceutical and lifestyle products (carbamazepine, caffeine, etc.) are used as effective tracers of anthropogenic contamination. Microbiological analyses are also undertaken to identify microbial populations associated with specific sources of pollution or specific biochemical reactions occurring in soil and groundwater. The resulting hydrochemical dataset is then processed using multivariate and clustering analyses.

In this context, the objective here is to describe the methodological approach developed for source identification and to illustrate this using a case study corresponding to a groundwater catchment is a chalk aquifer in Western Belgium.