

Type of presentation: Oral

Session: T2.3 Novel sampling, analysis, and monitoring techniques

Title:

Using pharmaceutical compounds as tracers of urban sources of nitrate in groundwater

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Keywords: Nitrate sources, groundwater, manure, wastewater, pharmaceuticals

Abstract:

Nitrate is a natural compound part of the nitrogen cycle. It is widely used in agriculture but urban waste water produced by anthropogenic activities can also constitute non-agricultural sources of nitrate. Nowadays, the significant increase of nitrate concentrations in groundwater presents a risk for human health. In order to set up adequate measures to protect water quality, it is necessary to determine the possible sources of nitrate such as fertilizers, manure or urban waste waters. Different approaches are available for such purpose based on hydrochemical and isotopic signatures but they remain relatively uncertain. Recent advances in the detection of pharmaceutical compounds at extremely low concentrations in groundwater (in the range of ng/L) offer the opportunity to use some of these substances as chemical tracers to differentiate among nitrate sources. In this context, groundwater samples were collected from public water supplies, natural sources, domestic wells and karstic springs in six different sites in the Walloon Region of Belgium. Classical inorganic chemicals, stable isotopes of nitrate and boron were measured. In addition, ten pharmaceuticals (e.g. diclofenac, carbamazepine, hydrochlorothiazide) among the most frequently detected in the region's waters were also quantified. The use of pharmaceutical compounds as chemical markers of urban water is only in its early stages. However, the results allowed to identify the most likely sources of nitrate in cases where isotopic analyses were unable to do it. Results show that using pharmaceuticals to discriminate nitrate sources (urban or agricultural) offers interesting perspectives for the future. In particular, the use of certain substances such as carbamazepine is promising.