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Identification of the nitrate contamination sources of the Brusselian sands groundwater body (Belgium) using a dual-isotope approach

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Knowledge of the groundwater pollution source is of primary importance to define appropriate remediation strategies. Yet, the identification of the contamination sources remains a complicated task. A dual isotope approach has been used to provide information for tracing sources of nitrate in water.
In this study, we used the naturally occurring stable isotopic composition of groundwater nitrate (1) to evaluate the origin of nitrate in the Brussels sands aquifer (Belgium) and (2) to study the temporal dynamics of the isotope signature of groundwater nitrate in this region.
Potential N sources sampled in the region, including e.g. ammonium and nitrate mineral fertilizers, sewage and rain, had isotopic signatures that fell within the corresponding typical ranges found in literature. Some of them however deviated from the isotopic ranges corresponding to typical N sources, illustrating the impact of processes affecting the isotopic signature of the nitrate sources.
During a pluri-annual sampling campaign, groundwater samples were collected at 10 moments between June 2007 and February of 2009 over 9 monitoring stations located in the western part of the study area. The isotopic data time series suggest that, most of the time, N applied on the soil has been cycled in the soil by micro-organisms before leaching to the groundwater, while the isotopic data and the high nitrate concentrations strongly suggests that nitrate of the groundwater sampled in January 2008 principally originates from mineral fertilizers.
The isotopic data measured at some of the 114 monitoring stations across the study area strongly suggests that the sources of nitrate are mineral fertilizers used in agriculture and golf courses, manure leaching from unprotected stockpiles in farms, domestic gardening practices, cesspools and probably cemeteries.
Isotopic data are particularly helpful when associated with other information like historical data about monitoring stations, land use, chemical parameters of water or statistical and deterministic models and must therefore be considered as one of the many elements of pollution sources identification.