

ISOTOPES OF NITRATES AND CFC-SF6 GROUNDWATER RESIDENCE TIME ASSESSMENT TO UNDERSTAND NITRATES TRANSFER IN A BASEMENT AQUIFER

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Insuring the quality of the drinking water supply in agricultural rural areas remains locally a challenge even if local authorities have made great efforts to restore the quality of the groundwater resources, especially regarding nitrates. This is the case of the Plourhan small city (~2000 inhabitants, about 10 km from the sea, NW France), where the drinking water is pumped in a natural spring emerging from the Brioverian basement. The spring presents nitrate concentrations exceeding the 50 mg/L standard for drinking water supply, and thus needs to be diluted with another groundwater resource with low nitrate content to be delivered to the population. Over the last 15 years, a large programme of measures was undertaken in order to reduce the NO₃ concentration. This programme includes the purchase of agricultural parcels around the spring, moving progressively from mixed farming and livestock to fallows and meadows, and thus drastically change the local land use. Despite all these efforts, nitrate concentrations only decrease very slowly and remain above the 50 mg/L standard.

In this context, the objective of this study is to better understand the transfer of nitrates at the basin scale that feeds the spring, and thus to better constrain the aquifer functioning, in order to predict the evolution of the water quality of the pumped spring. In that way, a geochemical and isotopic approach is applied at the basin scale. Major elements analysis of the groundwater reflect the drained contrasted lithologies as metasediments (pelites & sandstones) and amphibolite, with a large spatial heterogeneity of the NO₃ concentrations, ranging from a few mg/L to more than 50 mg/L. Nitrogen and oxygen isotopes of nitrates ($\delta^{15}\text{N-NO}_3$ and $\delta^{18}\text{O-NO}_3$) suggest that denitrification can occur locally in some wells presenting low or intermediate NO₃ contents, whereas other wells present high or low NO₃ concentrations without any evidence of denitrification processes. The mean residence time of groundwater is assessed through CFCs and SF6 dissolved gas measurements. Some wells preferentially in amphibolite, present water with low recharge temperature (around 6°C while the mean recharge temperature in Brittany is 11-12°C) correlated with low CFCs/SF6 values indicating that some very old groundwater (last glaciation : -19/17 k yrs) exists in the reservoir. Other ones in metasediments have modern water or a mixing between an old and a present day recharge. These results, together with structural and lithological detailed geological field mapping, help to draw up the conceptual model of the aquifer functioning regarding nitrates transfer.

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