



Is the measurement of the isotopic composition of nitrate a good tool for tracing sources of nitrate in groundwater?

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Isotopic biogeochemistry allows tracing of nitrogen sources in the environment. The dual approach i.e. ^{15}N and ^{18}O approach has been used for decades to determine the origin of nitrate in surface and groundwater. The isotopic composition of fertilizers differs for example significantly from that of nitrate in atmospheric deposition and nitrate produced by nitrification.

A long term study (30 years) based on the use of lysimeters and ^{15}N labelled nitrate showed that nitrate which is not immediately taken up by plants is assimilated into the organic matter pool. This pool produces nitrate, with an isotopic signature of “newly produced nitrate” and different from its origin (1).

Based on this study, the natural stable isotopic composition of nitrate ($\delta^{18}\text{O}-\text{NO}_3^-$ and $\delta^{15}\text{N}-\text{NO}_3^-$) was measured in water samples collected below the root zone or in aquifers from the Seine River basin. We compared these with the isotopic composition of nitrate from synthetic fertilizers and atmospheric deposition which represent the most significant sources of nitrogen in these systems. In addition, the $\delta^{15}\text{N}$ of the organic matter pool in cultivated soils from this area was analyzed.

The $\delta^{18}\text{O}-\text{NO}_3^-$ results show clearly that nitrate issued from highly fertilized agricultural soils are freshly produced through nitrification of reduced nitrogen in the soil, instead of being directly transferred through the soil profile from applied fertilizers, indicating the major role of the soil organic matter pool. Our results thus bring new insights in the understanding of nitrogen contamination of surface and groundwater from agricultural watersheds, emphasizing the role of soil organic matter as a buffer.

(1). Sebilo M., Nicolardot B., Mayer B., Pinay G. & Mariotti A. (2013). Long-term fate of nitrate fertilizer in agricultural soils. PNAS. 110 (45) : 18185-18189. doi/10.1073/pnas.1305372110.