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The role of the organic matter pool of agricultural soils in nitrate pollution : A multi-isotopic approach.

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A long term study (30 years) based on the use of lysimeters and of labelled nitrates has shown that leached nitrates are still enriched in ^{15}N. The contribution of the fertilizer to the total nitrate leaching is very poor.

Based of this experiment, natural stable isotopic composition of nitrates (δ^{18}O-NO_3^- and δ^{15}N-NO_3^-) have been measured in water samples collected below the root zone or in aquifers from the Seine river basin. We compared them with the isotopic composition of nitrates from synthetic fertilizers and from atmospheric deposition which represent the most significant sources of nitrogen in these systems for 50 years. We have also gathered data on the δ^{15}N of organic matter pool in cultivated soils. The δ^{18}O-NO_3^- results show clearly that nitrates issued from even 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 played by the soil organic matter pool. Accordingly, the δ^{15}N-NO_3^- of leached nitrates reflects the isotopic composition of the soil organic nitrogen, which differs from one pedo-lithological region to another. The reason why the isotopic composition of the organic nitrogen pool of agricultural soils differs from that of fertilizers and atmospheric deposition is probably linked to the importance of the processes of volatilization and denitrification affecting the nitrogen budget of agricultural soils. Our results thus bring new insights for the understanding of nitrogen contamination of surface and groundwater from agricultural watersheds, emphasizing the buffer role of soil organic matter.