Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.30717

Persistent Contaminants and Biogeochemical Cycles: Investigating Pesticide Effects on Nitrogen Cycle

BASTIEN REDON[1], MELANIE LONGCHAMP[2], MARIE MORERE[3], MATHILDE MONPERRUS[4] AND MATHIEU SEBILO[1]

[1]Sorbonne University
[2]SORBONNE University
[3]Université de Pau et des Pays de l'Adour
[4]Université de Pau et des Pays de l'Adour, E2S UPPA, CNRS, IPREM, Anglet, France

Despite the long-term prohibition of certain pesticides, such as atrazine in France, these compounds are still detected in groundwater at significant concentrations, raising concerns about their lasting impact on biogeochemical cycles. Understanding how these persistent contaminants influence nutrient cycling, particularly in unsaturated zones and groundwater, is crucial for assessing their environmental consequences. In this context, isotopic tools provide a powerful approach for tracing pollutant dynamics and microbial processes. This study investigates the effects of pesticides on denitrification kinetics and nitrate isotopic signatures, contributing to a more comprehensive understanding of nitrogen cycling in contaminated environments.

To explore these effects, a batch experiment was conducted under controlled conditions, testing two concentrations of S-metolachlor (0.5 µg/L and 5 µg/L) and two nitrate levels (30 mg/L and 300 mg/L). S-metolachlor, a widely used herbicide for weed control in maize, was selected due to its frequent detection in groundwaters. Denitrification rates and nitrate isotopic fractionation were monitored over time to assess potential shifts in microbial nitrate reduction processes.

Preliminary results indicate that while denitrification kinetics remain unchanged in the presence of S-metolachlor, nitrate isotopic fractionation is more pronounced in pesticide-treated samples. This suggests that S-metolachlor may influence microbial processes involved in nitrate reduction, leading to shifts in nitrogen isotope signatures.

These findings highlight the potential for pesticides - both currently used and those banned decades ago - to alter nutrient cycling in groundwater and unsaturated zones, with implications for nitrogen fate in agricultural and natural ecosystems.

By integrating isotopic approaches with the study of pollutant interactions in the nitrogen cycle, this research contributes to the development of interdisciplinary methods for tracing nutrient dynamics and contaminant fate in watersheds. Ultimately, these insights enhance our understanding of the long-term impact of pesticides on biogeochemical processes and support improved nitrogen management strategies for different environmental conditions such as agriculture