



Variability in carbon and nitrogen isotope fractionation associated with bacterial hydrolysis of atrazine

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Even after legislative prohibition in 1991 by the European Union, the pesticide atrazine and its metabolites are still detected in surface and ground water frequently exceeding the permitted drinking water concentration limit of 0,1 $\mu\text{g/L}$. Despite much recent research on atrazine, its risk assessment in the environment is still a major challenge because of the difficulty of establishing mass balances in the subsurface. To obtain a better insight into the fate of atrazine, we developed compound-specific stable isotope analysis (CSIA) for atrazine. CSIA has proven valuable for assessing organic contaminants in subsurface environments, on the one hand for source identification and on the other hand to trace (bio)chemical degradation reactions through isotope fractionation in the compounds. Such assessment is based on the Rayleigh equation and therein on the isotope enrichment factor ϵ , which must be determined experimentally beforehand.

In ongoing work, we therefore measured carbon and nitrogen isotope fractionation associated with biotic hydrolysis of atrazine. C and N isotope enrichment factors were determined in resting cell experiments for *Pseudomonas* sp. ADP, *Chelatobacter heintzii* and *Arthrobacter aurescens* TC1, strains that hydrolyse atrazine in the initial transformation reaction. Carbon and nitrogen isotope enrichment factors were distinctly different between the bacterial strains. However, when plotting shifts in carbon isotope ratios versus shifts in nitrogen isotope ratios the slopes of the different degradation experiments coincided well. These results give evidence that all bacterial strains were carrying out the same initial biochemical degradation reaction, but that the associated isotope fractionation, as represented by the enrichment factors, was masked to a different extent owing to different rate determining steps prior to the isotopically sensitive bond cleavage (commitment to catalysis). Our study therefore illustrates the benefit of multi-element isotope approaches to assess the environmental fate of atrazine by CSIA.