



Measurements of Pesticide-Specific Natural Isotope Fractionation: A New Approach to Assessing the Fate of Pesticides in the Environment

Sandra Reinnicke (1), Allan Simonsen (2), Sebastian R. Sørensen (2), Jens Aamand (2), and Martin Elsner (1)

(1) Helmholtz Zentrum München, Institute of Groundwater Ecology, Munich, Germany

(martin.elsner@helmholtz-muenchen.de, +49 (0)89 3187 3187), (2) Department of Geochemistry, Geological Survey of Denmark and Greenland (GEUS), Copenhagen, Denmark

The intensive use of pesticides in the last decades has led to their detection in ground and surface waters. When measuring contaminant concentrations, complete mass balances are not easily established, since dilution, evaporation or sorption are difficult to take into account. Also the alternative approach of estimating degradation from daughter-to-parent compound ratios may fail if some metabolites are quickly further degraded so that they are not detectable. New analytical approaches are therefore needed to provide better insight into the fate of pesticides in deeper soil layers and groundwater.

Compound specific isotope analysis (CSIA) determines the natural stable isotope composition of organic compounds. On the one hand, this makes it possible to use isotope values as fingerprints to determine the origin of a chemical substance. On the other hand, the bio-chemical reactions during biodegradation often cause an enrichment of the heavier isotope in the remaining substrate and of the light isotope in the resulting products. Such isotope fractionation is specific for certain reactions and may be used to investigate and monitor the fate of organic contaminants in groundwater. Therefore, CSIA has the potential to detect, quantify and even identify transformation reactions of organic compounds. In our current work we addressed the isotope fractionation associated with degradation of the important pesticide metabolite 2,6-dichlorobenzamid (BAM). In a first step, we optimized the GC-IRMS analysis to determine precise and accurate carbon and nitrogen isotope values of the target compound. Subsequently, we determined for the first time degradation-associated isotope fractionation in a biotransformation experiment with the bacterial strain MSH1. Changes in carbon and nitrogen isotope values of BAM were up to 22 ‰ and 38 ‰ respectively, after 95% degradation demonstrating the potential of CSIA to assess natural degradation of this compound.