

Using the ratio of herbicide parent compound to transformation product and groundwater dating to estimate attenuation rate in aquifers

JULIEN FARLIN*¹, MICHAEL BAYERLE, DENIS PITTOIS
AND TOM GALLÉ

¹Luxembourg Institute of Science and Technology, ERIN
department (*correspondence: julien.farlin@list.lu)

Herbicide degradation in aquifers is much slower than in the topsoil, where the microbial activity is highest. However, since the transit times can be orders of magnitude longer, significant attenuation can still take place in the subsurface. For the time scales involved, estimating transformation rates in-situ is difficult and constrained by logistical issues (sampling duration and sampling location), while the results of laboratory experiments are not easily transferable to real-world situations. We wish to present an indirect method based on changes in the ratio of a parent compound to one of its degradation product over time. The problem is formulated as a system of differential equations which can be solved inversely using measured herbicide concentrations. Combined with groundwater dating, providing a 'clock', the approach is tested in a fractured aquifer contaminated by atrazine and its transformation product desethylatrazine. Estimated degradation half-times were equal to ten years and longer, and agreed with independent estimates obtained using a physically-based numerical code.