



Groundwater dating with the helium-tritium method to assess the long-term persistence of pharmaceuticals and their residues in groundwater

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The helium-tritium dating method is based on the analysis of tritium combined with its decay product, the lighter and rare ^3He isotope. It was first suggested by Tolstikhin and Kamenskiy (1969) and has since been used in many groundwater studies. We applied the method to date groundwater recharged by bank filtration and former sewage irrigation onto sewage farms in Berlin, Germany, in order to assess the long-term persistence of several organic trace pollutants. In recent years, the occurrence of organic trace pollutants, such as pharmaceuticals and personal care products (PPCPs) as well as their metabolites, in the aquatic environment has been of increasing public and scientific interest (e.g. Schwarzenbach et al., 2006). In (urban) partly closed water cycles like Berlin, poorly biodegradable polar compounds may travel along the water path from wastewater via surface water to the raw water used for drinking water production (Reemtsma et al., 2006). In addition, raw or treated sewage irrigation onto sewage farms and/or agricultural land was common practice in Berlin until the 80s. Combined age dating and trace compound analysis revealed that several phenazone-type compounds (AMDOPH, AMPH, FAA and AAA) as well as a number of psychoactive compounds (meprobamate, pyrithyldione, primidone, and its metabolites phenobarbital and phenylethylmalonamide) are present in three decade old groundwater down gradient of a decommissioned sewage farm in Berlin, while a number of phenazone-type compounds (phenazone, propylphenazone, AMDOPH, AMPH) were present in decade-old bank filtrate. The results prove the long-term-persistence of the respective compounds under anoxic redox conditions, which are prevalent at the investigated sites. At the bank filtration sites, some of the compounds may regionally even be used as time markers for a certain infiltration period and reflect the surface water quality changes of the past few decades.

References:

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