Water pollution

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Following perfluoroalkyl acids through their journeys

Perfluoroalkyl acids (PFAAs) are a subgroup of per- and poly-fluoroalkyl substances (PFAS) which are known to be toxic to humans and ecosystems. The long-term leaching phenomenon of PFAAs can have alarming implications for the transport of these contaminants between the unsaturated zone and groundwater. Several models have been developed to describe the fate and transport of PFAAs in the subsurface. However, quantifying the PFAA transport in realistic geologic systems is still a challenge considering the complex subsurface conditions.

Now, William Gnesda from the University of Wisconsin and colleagues have developed a theoretical and semi-analytical approach to upscale PFAA adsorption parameters from the laboratory to the field scale. They expanded the existing models for describing PFAA adsorption to air–water interfaces and solid phases to study adsorption as a function of water saturation and height above the water table using the Oneida–Rhinelander Airport (ORA) adjacent to the impacted municipal wells in Northern Wisconsin as a case study.

They firstly measured the soil–water and the air–water adsorption coefficients and found that both mechanisms drive increased sorption as the number of carbon chains increases. In addition, air–water adsorption processes tend to dominate the retardation profile of PFAAs in the vadose zone under unsaturated conditions, explaining the observations of long-term adsorption and slow release of PFAAs to groundwater systems. At field scales, the capillary heterogeneity can result in large fluctuations in steady-state water saturation as a function of depth and thus fluctuations in air–water retardation. At the ORA site, capillary heterogeneity is driven by differences in the grain-size distributions of stratified glacial melt–water deposits that vary with depth.

One of the main methods presented in the paper is vertical integration, developed by Valocchi (*Water Resour. Res.* **25**, 273–279; 1989). This method attempts to reduce the complex vadose zone adsorption profile to representative single retardation factors, thus reducing computational complexity. Their future work aims to validate vertical integration methods.

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