A framework for assessing the contaminant sorption and retardation potential of aquifers

Jonathan Smith (1) and David Lerner (2)

(1) Shell Global Solutions, Chester, UK (jonathan.w.smith@shell.com), (2) Catchment Science Centre, Sheffield University, Sheffield, UK (d.n.lerner@shef.ac.uk)

Contaminants are subject to a range of degradation and retardation processes in aquifers and river-bed sediments. These pollutant attenuation processes are frequently evaluated when assessing and managing the risks associated with contaminated groundwater. Collectively they are referred to as natural attenuation (NA) processes and a number of regulatory standards and guides have been published that describe good-practice assessment and application of NA processes as a risk-management option.

This poster presents a screening framework that can help owners of multiple contaminated sites to identify those sites where pollutant retardation potential is likely to be greatest, and to help assessors prioritize further site-specific investigations of the significance of NA processes for risk management purposes. The screening framework includes classifications for the intrinsic aquifer attenuation capacity by sorption to organic matter, cation exchange and by acid buffering processes. The classification scheme is based on the results of modelling simulations to derive the geochemical properties of aquifers and sediments that produce environmentally significant attenuation. The screening framework has direct application in the initial assessment of natural attenuation processes, such as those described in the Environment Agency's monitored natural attenuation (MNA) guidance.

Retardation has the effect of slowing the apparent contaminant velocity, and thereby increasing travel times between source and receptor. This may provide additional time for destructive attenuation processes to occur, or for alternative risk-management strategies to be developed. The screening framework developed relies solely on information about the intrinsic geochemical properties of the aquifer through which a dissolved pollutant is migrating. It does not require additional site-specific data collection at the outset of a site evaluation.

The methods for determining representative attenuation potential classes are presented and attenuation classification scheme presented for organic carbon sorption, cation exchange and acid-buffering potential. The application of the classification scheme is illustrated with national-scale geochemical data from British aquifers, which illustrates how the natural attenuation potential varies spatially, and where further investigation is warranted as part of detailed risk evaluation.