British Geological Survey

Pesticides

The threat to our water supply

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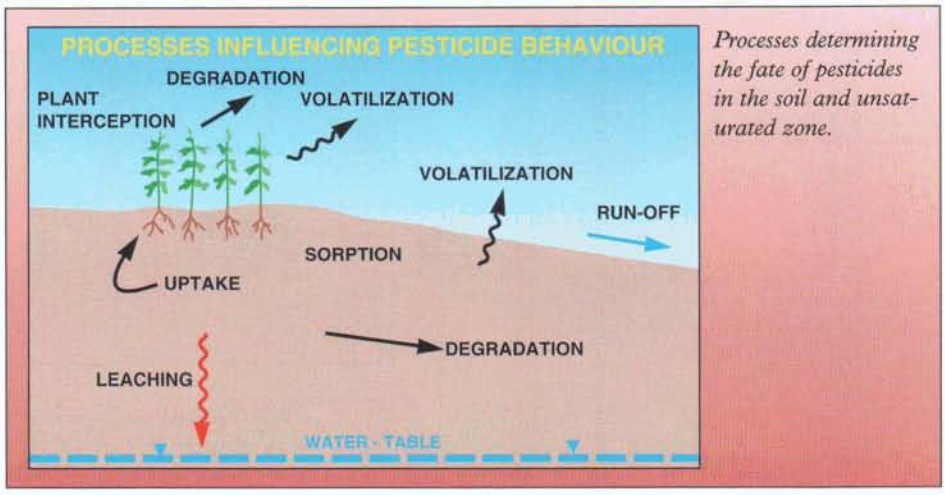

Processes determining the fate of pesticides in the soil and unsaturated zone.

The development of more intensive agriculture to meet increasing demands for food requires the use of fertilisers and pesticides. During the past 15 to 20 years much attention has been given to the impact of agriculture on groundwater quality through the leaching of nitrate. The BGS was at the forefront of this research, and played a key role in demonstrating the importance of understanding the way infiltrating rainfall transports nitrate and other potential pollutants from the soil to the underlying groundwater. Initially the research was concentrated in the United Kingdom, and was subsequently extended to tropical environments under the UK Department for International Development (formerly the Overseas Development Administration) Technology Research and Development Programme.

Knowledge of widespread nitrate pollution led to concern about the potential leaching of pesticides, the use of which increased dramatically during the 1970s and 1980s. In the UK, much of this increase in use was for weed control in cereal cultivation. All pesticide compounds pose a potential environmental health risk, since they are designed to be persistent and toxic to carry out their function of controlling weeds, insects or fungal growths. An increasing number of pesticides are being detected in groundwater as routine monitoring programmes are developed in response to tightening water quality standards. As hydrogeological conditions play a major role in determining whether pesticides can cause problems for groundwater users, it was natural that the BGS should apply its skills to this issue.

The risk of groundwater pollution depends very much on the available pathways for transporting pesticide residues from the soil. Slow movement through the mass of soil and rock would allow plenty of time for the pesticide to be reduced in level by adsorbtion to small particles in the aquifer and by biological breakdown. Rapid infiltration of groundwater might allow residues to move downwards much more quickly, without time for these processes to be effective. Chalk, sandstones and limestones form our major aquifers. Characterising the rock matrix and fractures that allow water to move through them and assessing their influence on groundwater and pollutant movement is a key research objective for the BGS.

The BGS approach to the study of pesticides involves a combination of field and laboratory studies and mathematical modelling. Because pesticides need to be determined at very low concentrations which can be compared with the drinking water standard of 0.1 micrograms per litre, new methods of sampling and analysis have been developed. Drilling and sampling has been able to confirm that only small quantities of pesticide move downwards through the rock matrix, and these are unlikely to produce problematic concentrations in groundwater. Current efforts in the field are concentrated, with our sister organisation, the Institute of Hydrology, on determining the climatic and soil moisture conditions which would allow more rapid movement to occur. In addition, methods are being developed to sample such flow when it occurs. Laboratory studies by the BGS's microbiologists and analytical chemists have shown that pesticides can be much more persistent once they pass below the soil layer, as rocks contain smaller microbial populations and less nutrients for them to degrade pesticides. Similar approaches have been applied to pesticides and in different geological environments in collaboration with researchers in India, Sri Lanka, Barbados and Mexico.

Pesticides are also applied extensively in non-agricultural situations as general weedkillers on railways, roads and other paved areas. Runoff from such areas could carry pesticides rapidly into the ground, especially if soakaways are used to facilitate rapid drainage. Pesticides which have been used in this way have been detected in public supply sources, and the BGS has carried out investigations of such occurrences for water companies. Differentiating between agricultural and non-agricultural origins and determining the possible pathways by which pesticides can reach groundwater is clearly essential if appropriate control measures are to be implemented to protect our groundwater resources.