Phytoscreening for vinyl chloride in groundwater discharging to a stream

This study applies an optimized phytoscreening method to locate a chlorinated ethene plume discharging into a stream. To evaluate the conditions most suitable for successful phytoscreening, trees along the stream bank were monitored through different seasons with different environmental conditions and hence different uptake/loss scenarios. Vinyl chloride (VC) as well as cis-dichloroethylene (cis-DCE), trichloroethylene (TCE), and tetrachloroethylene (PCE) were detected in the trees, documenting that phytoscreening is a viable method to locate chlorinated ethene plumes, including VC, discharging to streams. The results reveal, that phytoscreening for VC is more sensitive to environmental conditions affecting transpiration than for the other chlorinated ethenes detected. Conditions leading to higher groundwater uptake by transpiration than contaminant loss by diffusion from the tree trunks are optimal (e.g., low relative humidity, plentiful hours of sunshine and an intermediate air temperature). Additionally, low precipitation prior to the sampling event is beneficial, as uptake of infiltrating precipitation dilutes the concentration in the trees. All chlorinated ethenes were sensitive to dilution by clean precipitation and in some months, this resulted in no detection of contaminants in the trees at all. Under optimal environmental conditions the tree cores allowed detection of chlorinated solvents and their metabolites in the underlying groundwater. Whereas, for less ideal conditions there was a risk of no detection of the more volatile VC. This study is promising for the future applicability of phytoscreening to locate shallow groundwater contamination with the degradation products of chlorinated solvents.