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Migration of Phenoxy Acids, DNOC, and other Herbicides in Fractured Clayey Tills

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Pesticides, in particular certain herbicides and herbicide metabolites, have during the last years been recognized as groundwater contaminants. Groundwater constitutes an important drinking water resource. Overlying low permeability materials such as clayey tills often serves to protect groundwater aquifers. However, clayey tills are often fractured. Water may be transported rapidly through fractures. The migration of dissolved contaminants in fractured aquitards is retarded by matrix diffusion. Hence, matrix diffusion of herbicides in clayey tills is an important parameter for the evaluation of the potential risk of groundwater contamination from herbicide use. Currently, there are practically no available data on herbicide diffusion in clayey till or other aquitard materials.

The matrix diffusion of the herbicides: MCPP, MCPA, 2,4-D, dichlorprop, bentazone, isoproturone, DNOC, atrazine, and dichlobenil, and the dichlobenil metabolite BAM, are studied in ongoing laboratory experiments with intact clayey till cores from 3 Danish fieldsites. One end of each intact clayey till is exposed to a reservoir with near constant concentrations of selected herbicides for periods of 1 to 4 months. Bromide is added as a tracer during the last ½ month. The cores are sampled (2 to 5 mm slices), extracted, and analyzed. Effective diffusion and sorption parameters are derived from the data by use of an analytical solution to Fickian diffusion.

Preliminary results for one of the clayey tills correlate reasonably well with expected diffusion profiles for the phenoxy acid herbicides, bentazone, and BAM. These herbicides, though of low sorptivity, are significantly retarded by matrix diffusion. They will migrate much slower than the water in the fractures though faster than tracers of small molecular size such as bromide. The mass-loss and hence retardation of the herbicides during migration through fractured clayey till will be further evaluated based on a large intact fractured clayey till column study with herbicides this summer.