

Methods to assess leaching and transport from contaminated sites

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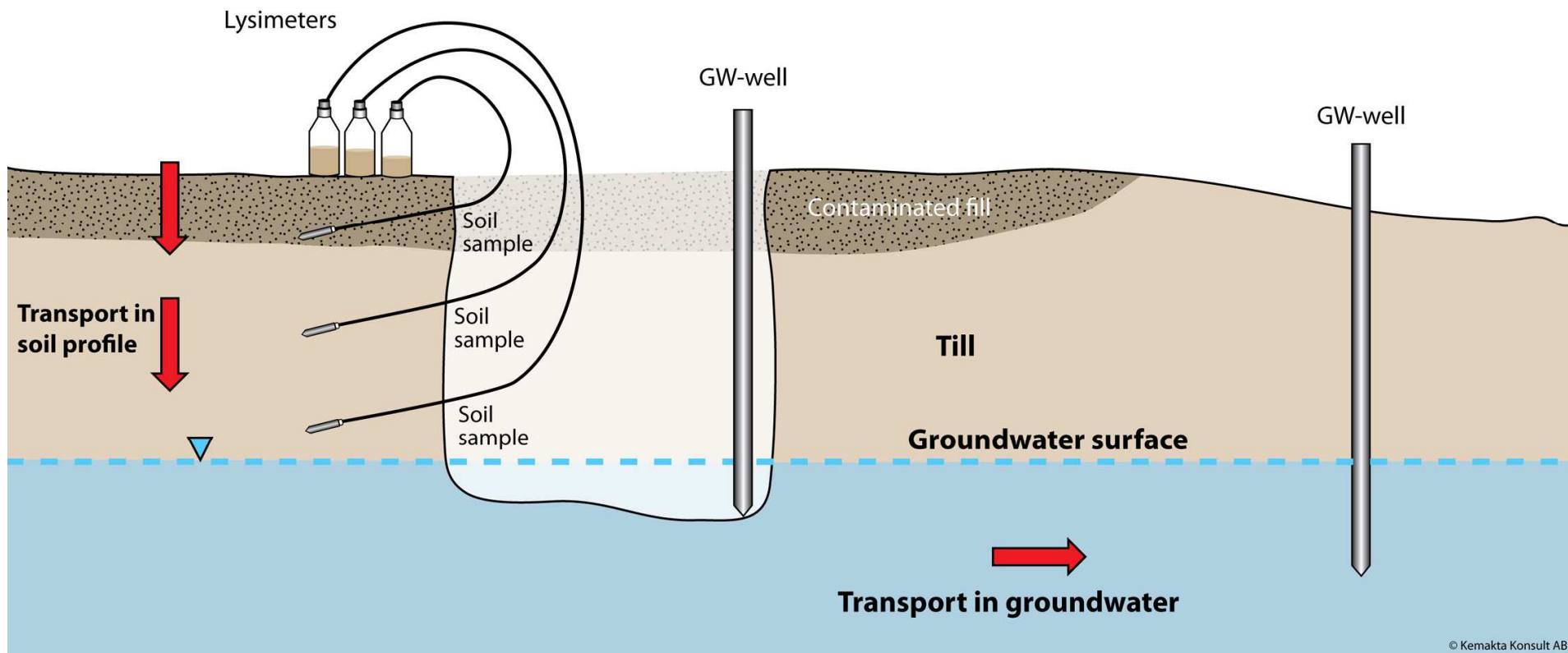
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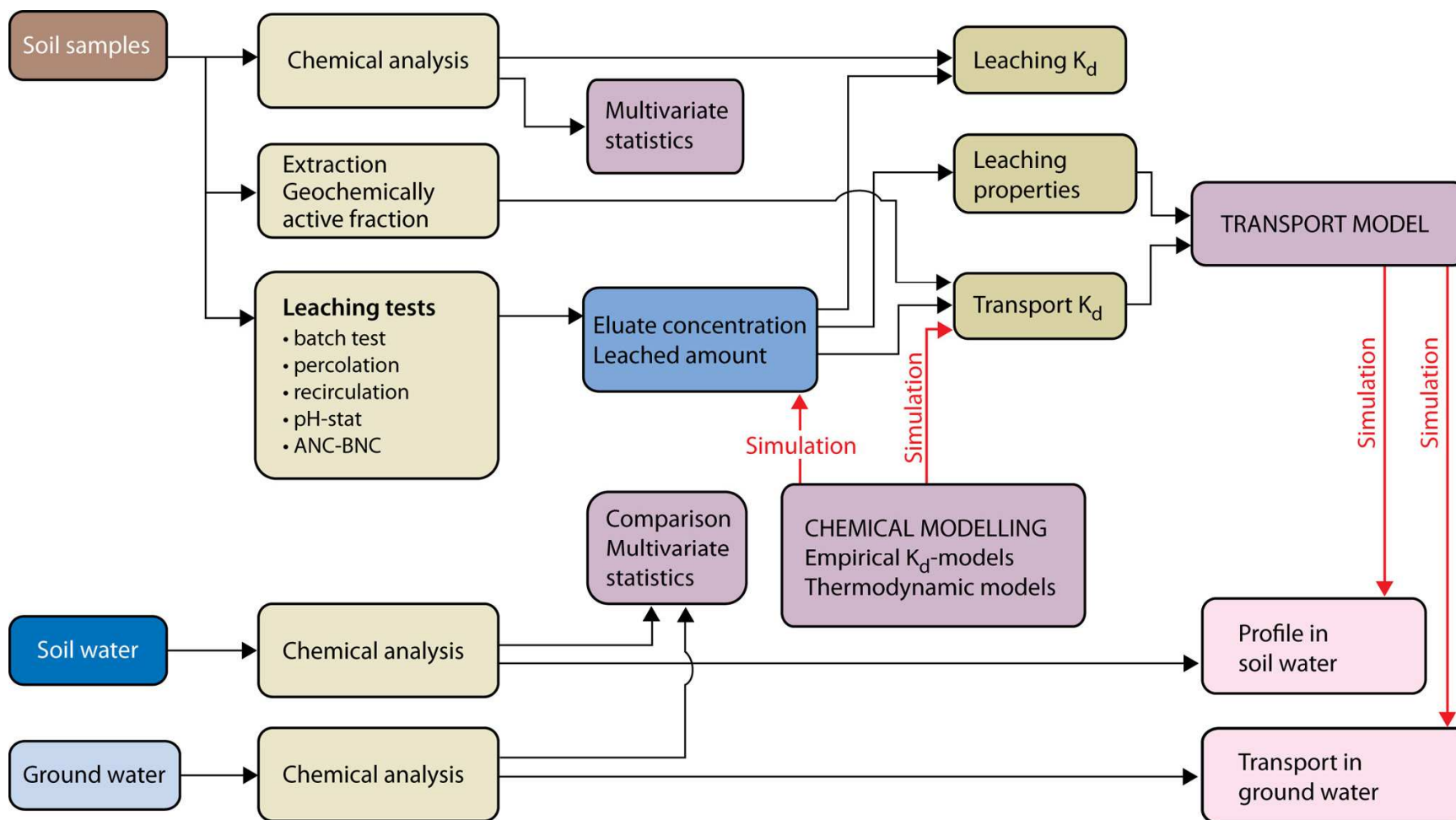
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Purpose and aim

- Test methods for assessing leaching and transport of contaminants
- Evaluate their use in risk assessment
- Investigations at two sites :
 - Foundry in Gnosjö (Cd, Cu, Pb, Ni, Zn)
 - Wood treatment facility – CCA and cresote - at Nässjö (As, Cu, Zn, PAH)



Overview of project

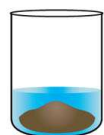


Leaching tests

Batch test (Two step leaching L/S=2 och 10)

Step 1

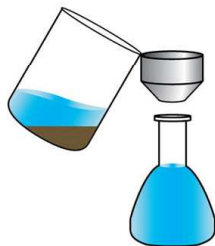
L/S=2
175 g soil
350 g leachant



Agitation for 6 hours



Eluate is
decanted
and filtered



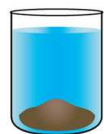
Sample for
analysis



Leached amount at L/S=2 (mg/kg)
is calculated from the eluate
concentration

Step 2

~1400 g new
leachant added
to a total L/S=10



Agitation for 18 hours



Eluate is
decanted
and filtered



Sample for
analysis

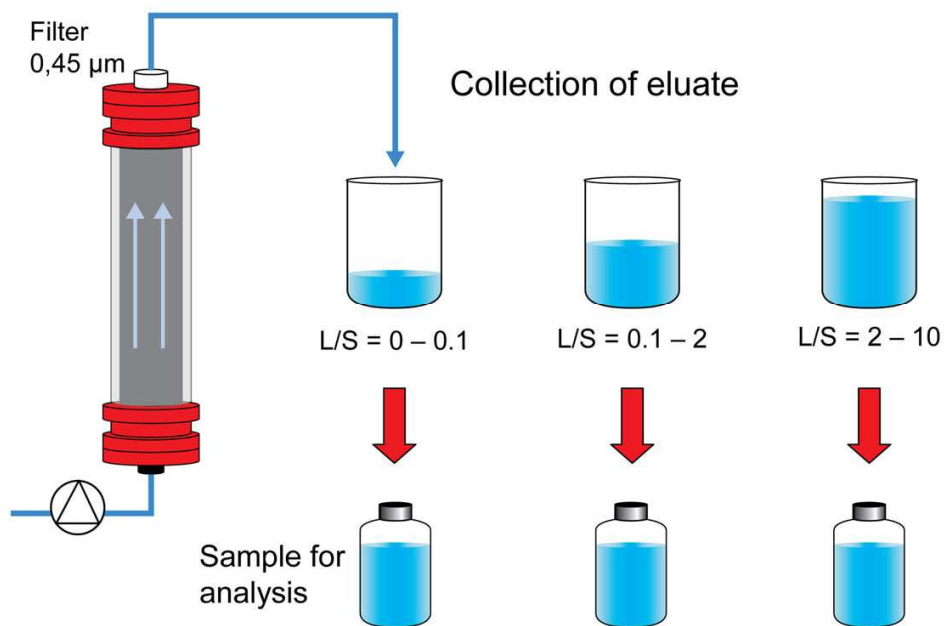


Leached amount at L/S=10 (mg/kg)
is calculated from the eluate
concentration and amount leached
in Step 1

Percolation tests

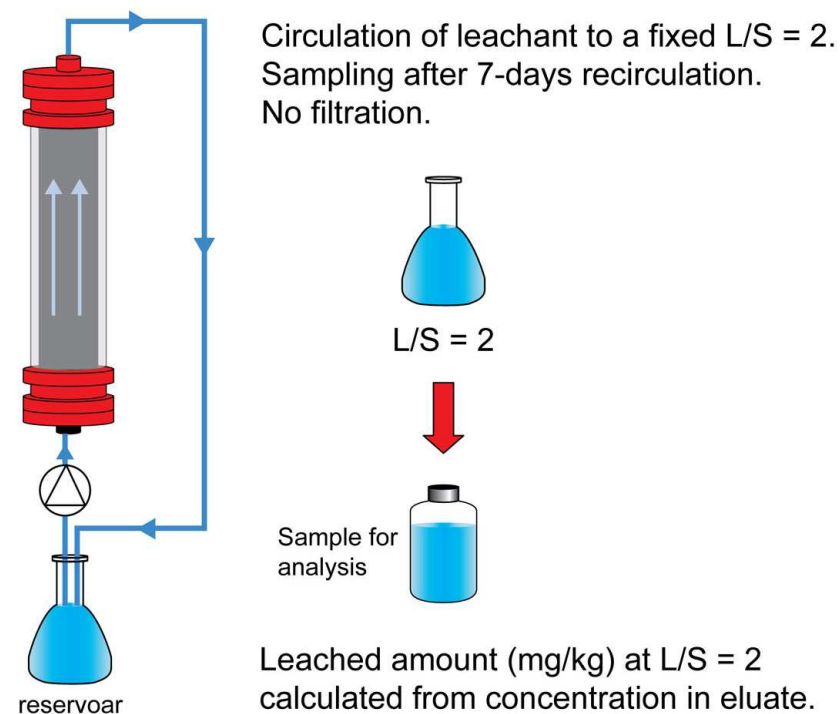
Percolation test

Sampling at L/S= 0,1, 2 and 10



Leached amount at accumulated L/S at 0.1, 1, 2 and 10, respectively, is calculated from concentration in eluate.

Percolation test with recirculation

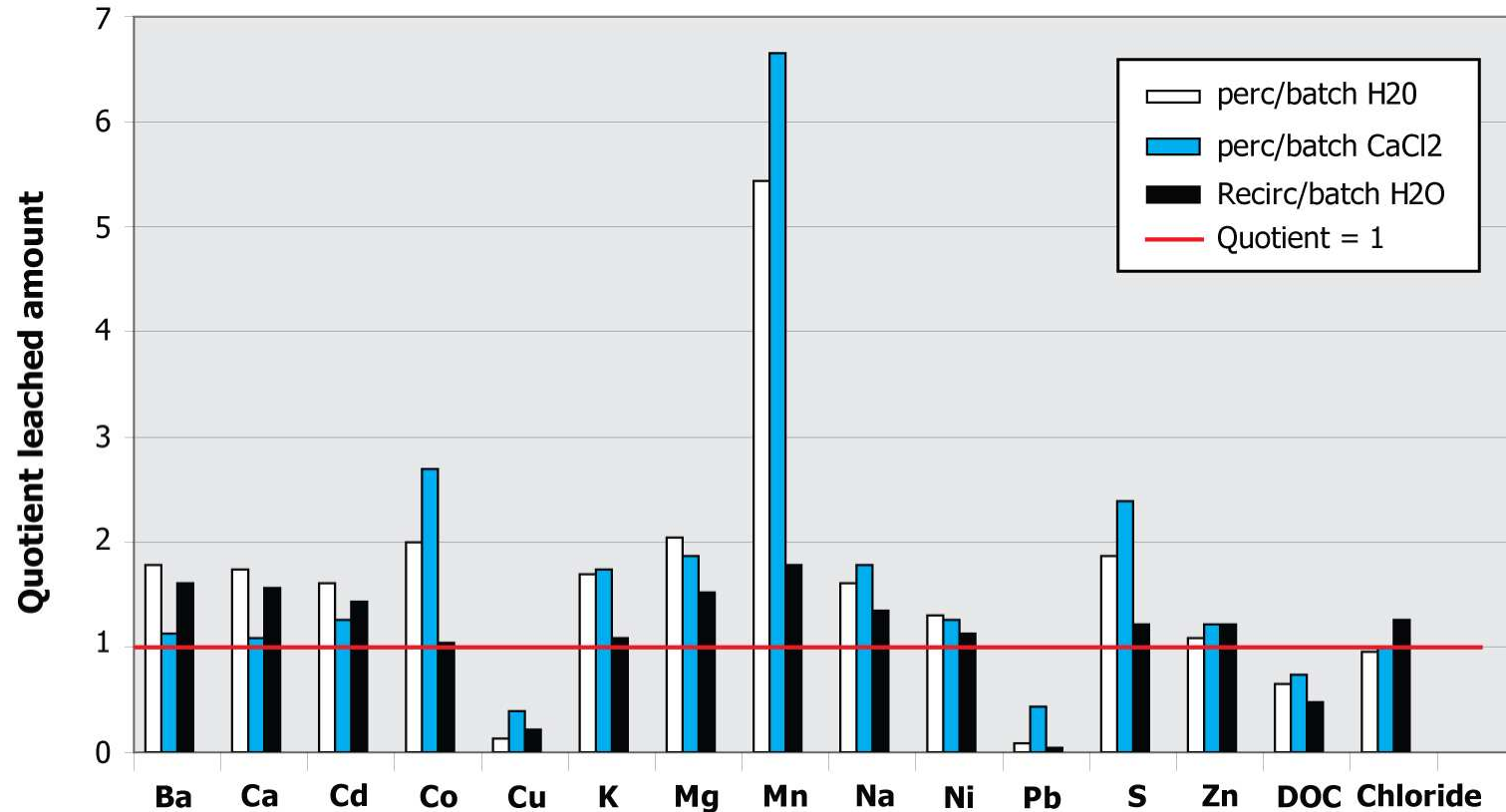


Leached amount (mg/kg) at L/S = 2 calculated from concentration in eluate.

Leaching of inorganic substances

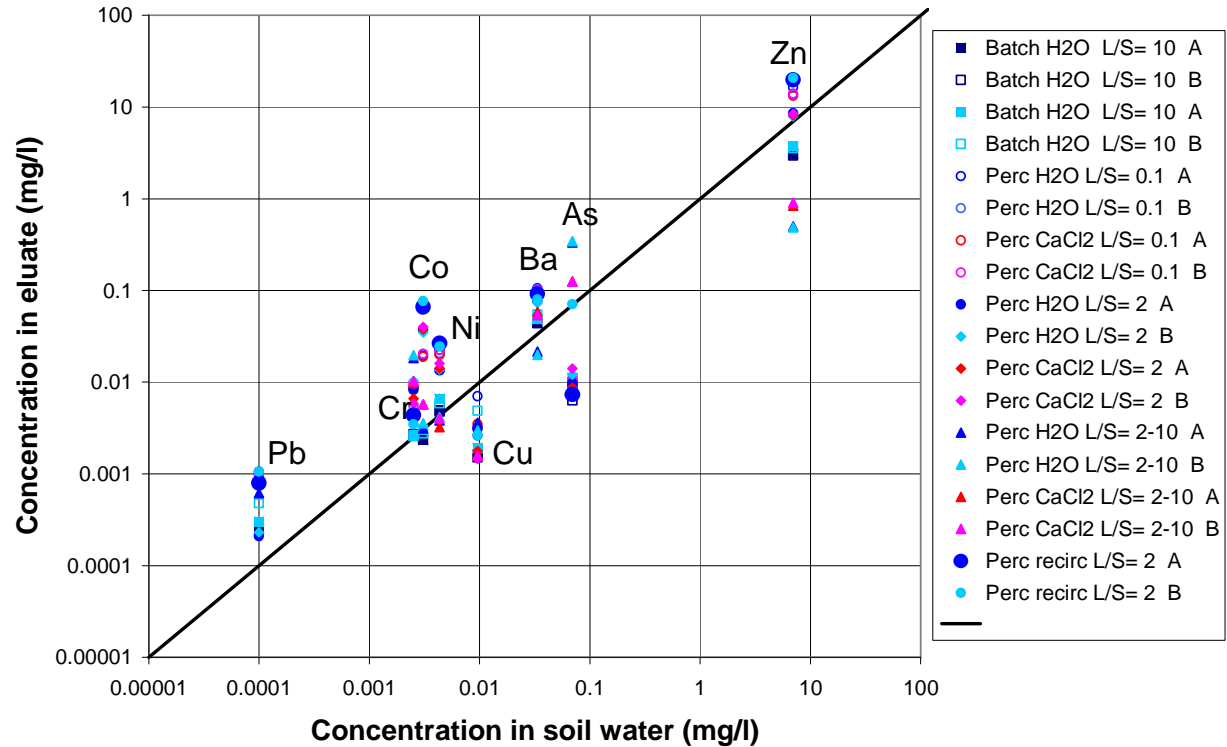
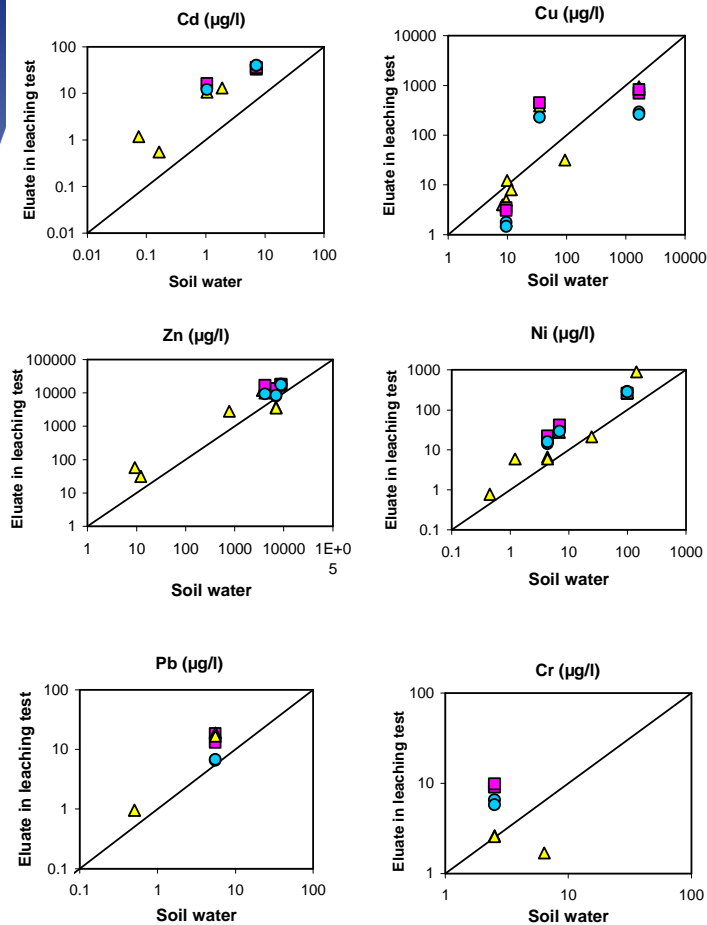
Comparison test method

Tö 2: 0-30 L/S=2



- Good repeatability (although only a few samples)
- In general small differences between test methods
 - Percolation tests gave higher leaching of Co, Mn, at CCA-site also As, Cr, Fe
 - Batch tests gave higher leaching of Cu and Pb – correlated to organic carbon
- Varying influence of leachant (deionized water/CaCl₂)
 - CaCl₂ gave higher leaching of Ba, Cd, Ni, Zn and Co, but lower for Cu and Pb

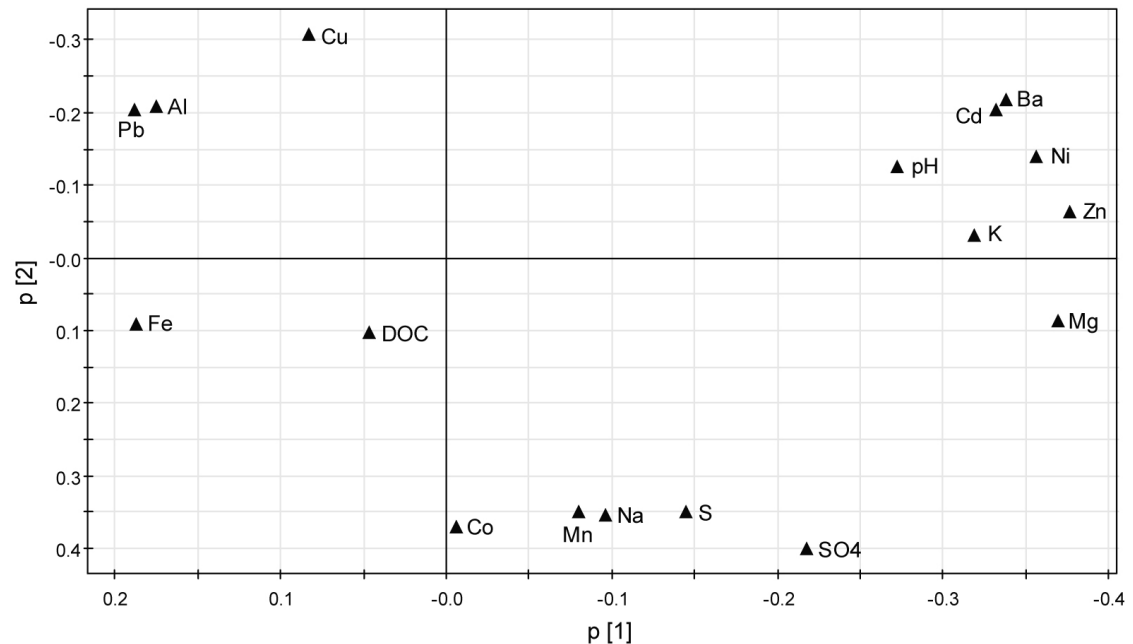
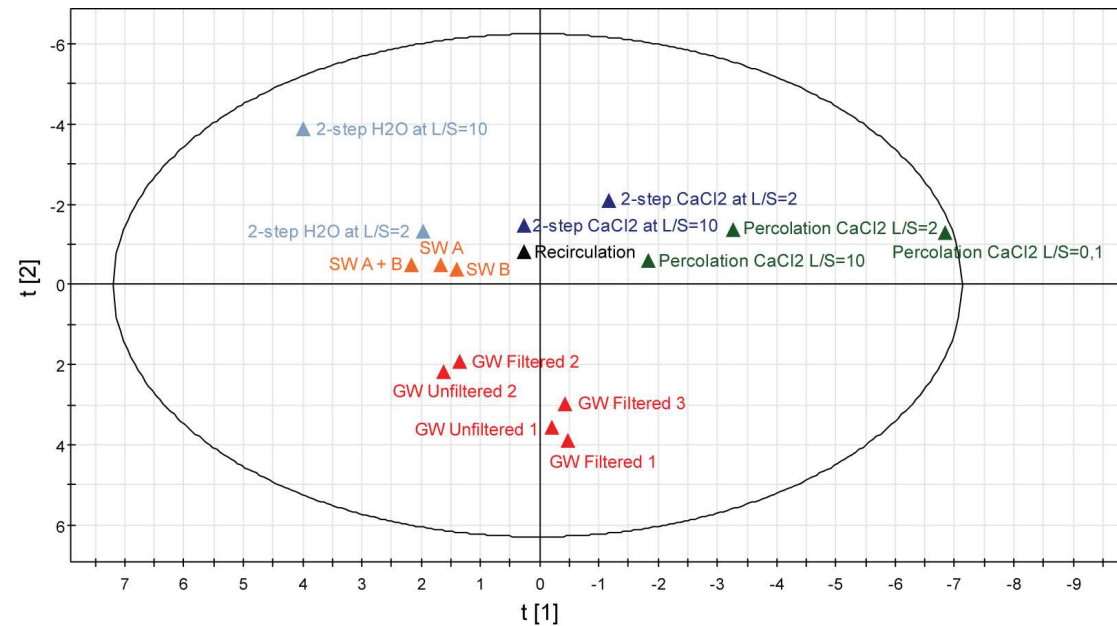
Comparison concentrations leaching tests and soil water



- Concentration in eluate and soil water in most cases within a factor of 10
- No test method consequently over- or underestimates concentrations in soil water

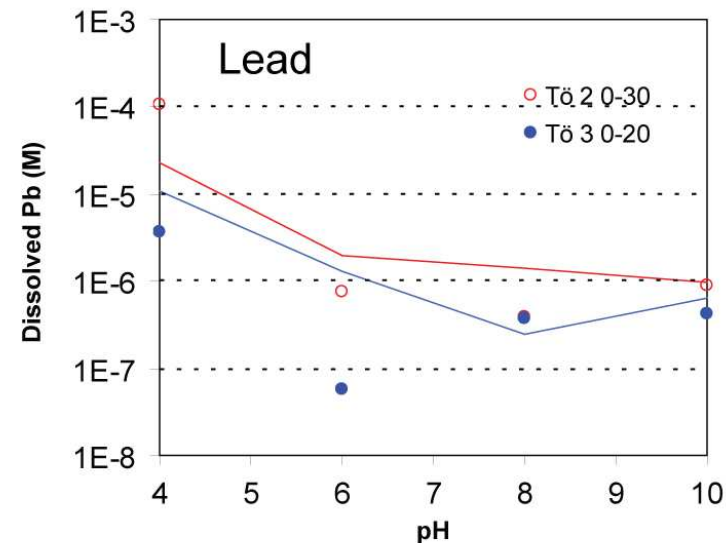
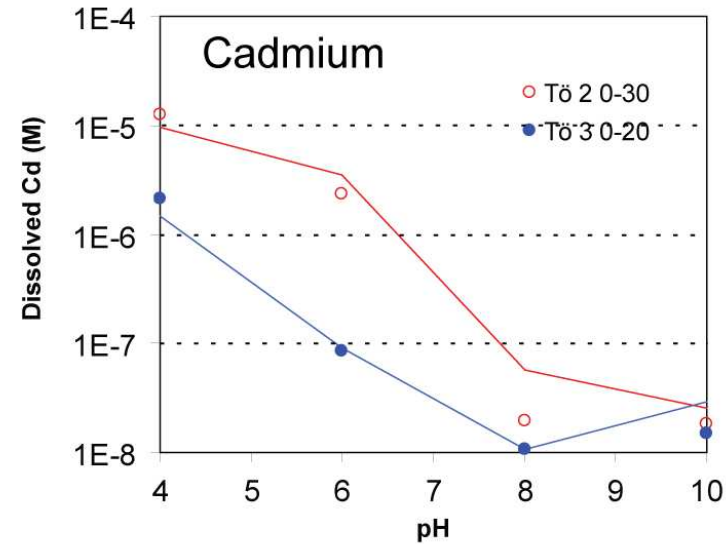
Multivariate statistics

- Statistical evaluation using Principal Components Analysis (PCA)
 - Aid in the evaluation
 - Demonstrate use of PCA
- Analysis based on all parameters
 - Metals
 - Inorganic constituents
 - pH
 - DOC
- Useful tool to analyse large quantities of data
- Good overview of the results of the test methods



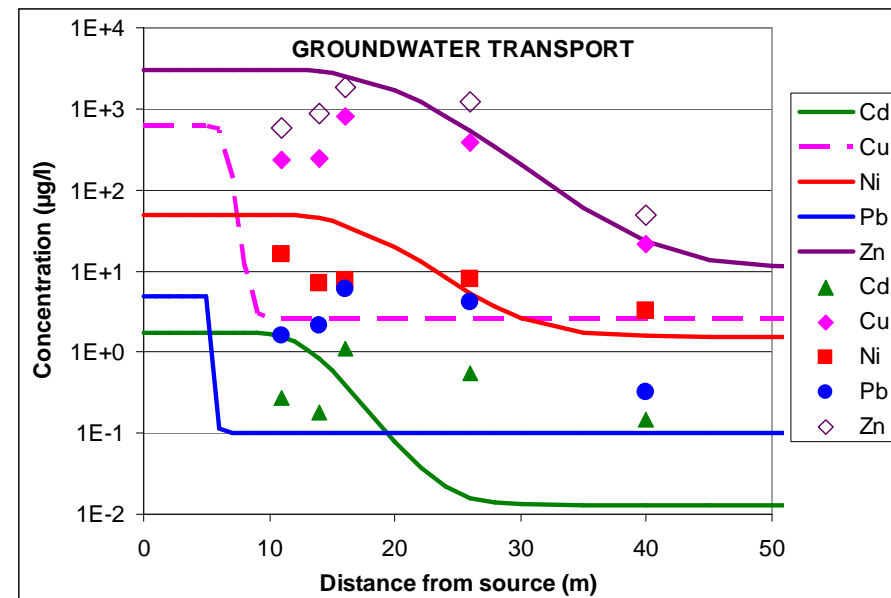
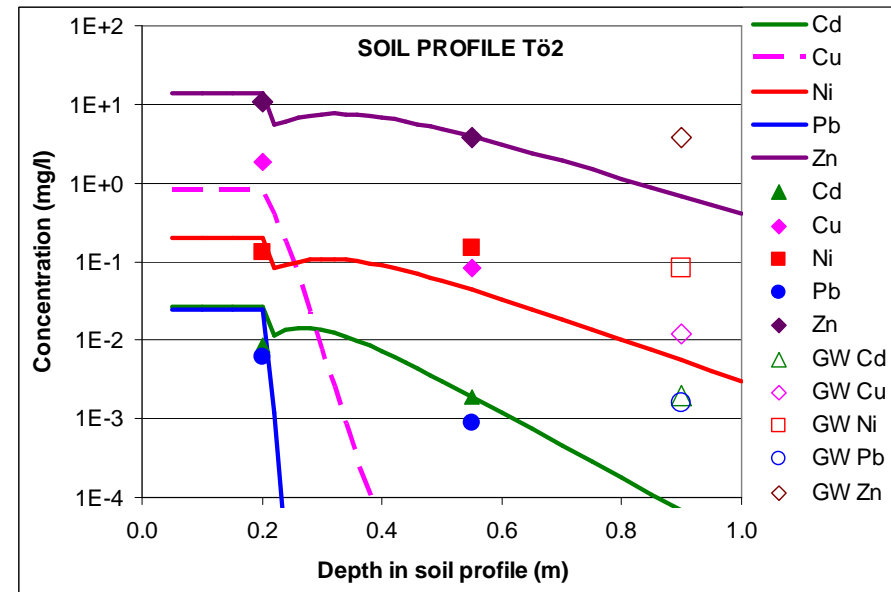
Chemical modelling

- Thermodynamic modelling
 - Speciation of metals using data from leaching tests
 - Simulation of metal concentrations
 - Possible to simulate future changes
- Prediction of K_d -values with empirical model
 - Good results for deeper soil profiles.
 - Not as good for the heavily contaminated surface layer.



Transport modelling

- Simulations of concentration profiles in soil water and groundwater
 - Simple Risk Assessment model
 - Advection-dispersion model
- The simple model overestimates concentrations in groundwater (as expected)
- Simulations with the AD-model (*lines*) gives a reasonable fit of measured profiles in soil and groundwater (*symbols*) for Ni, Zn (Cd), but underestimates the mobility of Cu and Pb



Conclusions

- Lysimeters are useful to study inorganic substances in soil water. In our study they were not as successful for organic substances (PAH).
- Standardised leaching methods provide valuable and useful information for risk assessments.
- Chemical modelling gives increased understanding of the processes.
- Simulations with Swedish model for soil guidelines using site-specific data gave reasonable estimates of soil water concentrations, but overestimated those in groundwater.
- A more advanced model could simulate transport of Cd, Ni and Zn, but tended to underestimate the mobility of Cu and Pb. Possibly due to co-transport by DOC or small particles.