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Sorption of organic chemicals at biogeochemical interfaces – calorimetric measurements

J. Krüger (1), F. Lang (1), J. Siemens (2), and M. Kaupenjohann (1)

(1) Department of Soil Science, Institute of Ecology, Berlin University of Technology, Salzufer 12, D-10587 Berlin, Germany (jaane.krueger@tu-berlin.de / +0049-30-31473548), (2) Institute of Crop Science and Resource Conservation, Division Soil Science, University of Bonn, Nußallee 13, 53115 Bonn, Germany

Biogeochemical interfaces in soil act as sorbents for organic chemicals, thereby controlling the degradation and mobility of these substances in terrestrial environments. Physicochemical properties of the organic chemicals and the sorbent determine sorptive interactions.

We hypothesize that the sorption of hydrophobic organic chemicals ("R-determined" chemicals) is an entropy-driven partitioning process between the bulk aqueous phase and biogeochemical interface and that the attachment of more polar organic chemicals ("F-determined" chemicals) to mineral surfaces is due to electrostatic interactions and ligand exchange involving functional groups.

In order to determine thermodynamic parameters of sorbate/sorbent interactions calorimetric titration experiments have been conducted at 20°C using a Nanocalorimeter (TAM III, Thermometric). Solutions of different organic substances ("R-determined" chemicals: phenanthrene, bisphenol A, "F-determined" chemicals: MCPA, bentazone) with concentrations of 100 μmol l^{-1} were added to suspensions of pure minerals (goethite, muscovite, and kaolinite and to polygalacturonic acid (PGA) as model substance for biofilms in soil. Specific surface, porosity, N and C content, particle size and point of zero charge of the mineral were analyzed to characterize the sorbents.

The obtained heat quantities for the initial injection of the organic chemicals to the goethite were 55 and 71 μJ for bisphenol A and phenanthrene ("R-determined representatives") and 92 and 105 μJ for MCPA and bentazone ("F-determined" representatives). Further experiments with muscovite, kaolinite and PGA are in progress to determine ΔG and ΔH of the adsorption process.