Simultaneous sorption of lead(II), copper(II) and chromium(III) in column experiments with undisturbed acid forest soils

Considering that soil acidification is increasing, the long-term accumulation of heavy metals in forest soils present a danger for the ground water and life forms found in soils. This is due to the fact, that the soils` sorption capacity of heavy metals is limited and practically all metals are more soluble at a lower pH-value. Additionally, metals are most readily available for plants at lower pH-value.

In this study, the loading of acidic forest soils with the heavy metals lead(II), copper(II) and chromium(III) was simulated in the laboratory under conditions very close to nature over a long period of time. This simulation was undertaken in order to examine competition effects and to evaluate maximum sorption capacities. Aim of this study was to predict the fate of heavy metals accumulated in soil during further loading and increasing soil acidification.

At first, the breakthrough curves derived from the undisturbed soil columns showed, that chromium(III) displaces lead and copper from binding sites on organic matter, when the load of the soils is high. Secondly, chromium was sorbed more efficiently in soil columns, whereas lead and copper showed complete breakthroughs. When comparing the degree of sorption of column experiments with sorption isotherms derived in batch-experiments, it showed, that during simultaneous loading of soils an equilibrium of all reactions, involved in sorption, is finally reached after 14 days of shaking. This is because chromium(III) forms, in contrast to lead and copper, kinetically stable complexes. As a consequence, a release of metals in the soil through chromium(III) can not be excluded, especially considering increasing soil acidification.