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Titel
The leaching of natural colloids from forest surface soils and their role for the P transfer

Abstract

Soil nanoparticles (d<100nm) and colloids (d<1µm) exert a decisive control on the mobilisation of strongly sorbing compounds such as phosphorus (P). We investigated the nanoparticles and colloids present in forest soil leachates examining their role for the P fixation and for the vertical P transfer in forest soils.
Mesocosm experiments with three German forest soils (upper 20 cm) were conducted. The mesocosms were irrigated with artificial rain for 22 months and the nanoparticles and colloids were characterised in the soil leachates with special attention to P.
The field flow fractionation (FFF) technique coupled online to UV- and DLS- detectors and inductively coupled plasma mass spectrometry (ICP-MS) or to an organic carbon detector (OCD) enabled a size resolved characterization and quantification of the nanoparticulate and colloidal fractions and their elemental composition (P, C_{org}, Fe, A, Si, Ca. Mn). To visualise and better characterise the particles present in the leachates, transmission electron microscopy with energy-dispersive x-ray spectroscopy (TEM-EDX) measurements were performed.
The translocated particles exhibited sizes up to 350 nm. Using FFF we separated the colloids in three size fractions i) 3-20 nm ii) 20-70 nm and iii) 70-350 nm. The particle fractions showed different chemical compositions. However their composition and characteristics were similar between the three forest sites and comparable to the natural nanoparticles and colloids from soils ("water dispersible colloids") and streams described in literature.
Up to 90% (on average ~45 %) of the leached P was associated with the nanoparticles and colloids. Our qualitative and quantitative analysis of the soil leachates showed that nanoparticles and colloids are crucial vectors controlling the P fluxes in forest ecosystems and could be a significant, but as yet still poorly quantified P loss factor.