Phosphorus-bearing particles in leachates from agricultural soils

MAGNUS SIMONSSON[1*], GBOTEMI ADEDIRAN[1], HELENA ARONSSON[1], ARARSO ETANA[1], JON PETTER GUSTAFSSON[1], STEPHEN HILLIER[1,2], DANIEL LUNDBERG[3]

[1]Swedish University of Agricultural Sciences (SLU), Department of Soil and Environment, Uppsala, Sweden (correspondence: *magnus.simonsson@slu.se)
[2]The James Hutton Institute, Aberdeen, UK
[3]SLU, Department of Molecular Sciences, Uppsala, Sweden

Dispersion and leaching of soil particles bearing phosphorus (P) is a major cause of eutrophication of surface waters derived from agricultural land. Knowledge on the origin and composition of these particles is needed to design relevant measures to reduce the losses of soil P. We investigated leachates collected from tile drains of five agricultural experiments in south and central Sweden, in which the topsoil texture ranged from loamy sand to silty clay.

For the clayey sites (clay loam or finer), the suspension load >0.2 μm was the strongest predictor (r = 0.77–0.99) of total P concentration in the leachates. Typically, 60–90 % of leached P was associated with >0.45 μm particles.

Dynamic light scattering performed on leachates showed a predominance of particles in the 0.1–1.0 μm size range, which occasionally formed aggregates 1–10 μm or larger that partially decomposed under ultrasonic treatment. A dominant contribution of fine clay minerals with an origin in the topsoil was suggested by X-ray diffraction patterns, which showed a high degree of hydroxy-aluminium interlayering, similarly to the topsoil. Total-organic-carbon data of the most turbid samples suggest that the leached particles contained up to 10 % organic matter or more, further indicating selective loss of particles from the surface horizon. Compared to the topsoil, the leached particles were enriched in P by a factor of 2–3, and in iron (Fe) by a factor of 2.

The results suggest that clay minerals and organic matter, leaching from the topsoil through macropores to the drains at ca 1 m depth, are important carriers of particle-bound P, as further corroborated by spectroscopic measurements P (Adediran *et al.*, this issue). The role of hydrous-oxide phases of Fe is subject to further investigation within the project.