Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.5162

Analytical investigations to estimate phosphorus re-dissolution rates in trace levels of selected topsoils and river sediments

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Anthropogenic phosphorus (P) input from different fertilised agricultural topsoils into surface water and re-dissolution from sediments play a vital role in eutrophication. This study aimed to (i) analyse the P input and re-dissolution processes into streams/rivers and (ii) to study the effectiveness of the riparian strip in reducing P emissions from diffuse sources. Three laboratory experiments were designed to analyse P re-dissolution and leaching behaviour from topsoils and sediments and further extrapolated to reality based on the P main input path into surface waters, which is erosion [1].

In all three experiments, the first extraction after drying and sieving had significantly higher total P concentrations compared to inorganic phosphate, which was attributed to organic P. It was found, that the P re-dissolution rate was strongly related to the O_2 concentration, E_h, T, pH and ionic strength. It was shown that the P re-dissolution rate decreased with increasing dissolved Ca^{2+}, Fe^{2+} and Mn^{2+} present.

The results indicated that the main P source into surface waters was leaching from sediment interstitial sites (57.5%) received due to percolation while the P re-dissolution via diffusion (13%), due to two heavy rain events (17%) and leaching processes through soil interstitial sites (12.5%) only played a minor role. The "Bund/Länderarbeitsgemeinschaft Wasser (LAWA)" orientation value causing eutrophication for total P (0.10 mg L^{-1}) [2] was exceeded in all sandy soils (0.17–0.85 mg L^{-1}), only slightly in the clayey soils (≤ 0.11 mg L^{-1}) and not in both sediments (≤ 0.08 mg L^{-1}). P-Fertilisation led to higher extracted P concentrations from soil by deionised/synthetic water than unfertilised soils. However, local differences such as a steeper slope, different soil compositions (sand, clay content), as well as poorer buffering due to lower lime content were the decisive reasons for a higher risk of eutrophication. The effectiveness of the riparian strip at the sites investigated is discussed as well.

References

[1] Tetzlaff, Kreins, Kuhr, Kunkel, Wendland (2017), *IBG 3 Agrosphäre*, 153–154.

[2] Bund/Länderarbeitsgemeinschaft Wasser (LAWA) (2015), *RaKon Part B Workpaper*, 13-14.