



Dissolved organic phosphorus (DOP) and its potential role for ecosystem nutrition

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During ecosystem development and soil formation, primary mineral sources of phosphorus are becoming increasingly depleted. Inorganic phosphorus forms tend to be bound strongly to or within secondary minerals, thus, are hardly available to plants and are not leached from soil. What about organic forms of phosphorus? Since rarely studied, little is known about the fluxes of dissolved organic phosphorus (DOP) forms and their role in the P cycle. However, there is evidence that DOP is composed of some plant-derived organic phosphorus compounds, such as phytate, which are less mobile and prone to be sorbed to mineral surfaces, whereas microbial-derived compounds like nucleic acids and simple phospho-monoester may represent more mobile forms of soil phosphorus. In our study, we estimated fluxes, composition, and bioavailability of DOP along a gradient in phosphorus availability at five sites on silicate bedrock across Germany (Bad Brückenau, Conventwald, Vessertal, Mitterfels and Löss) and at a calcareous site in Switzerland (Schänis). Soil solution was collected at 0 down to 60 to 150 cm soil depth at different intervals. Since most solutions had very low P concentrations (<0.05 mg total dissolved P/L), soil solutions had to be concentrated by freeze-drying for the enzymatic characterization of DOP. In order to test the potential bioavailability, we used an enzyme assay distinguishing between phytate-like P (phytate), diester-like P (nucleic acids), monoester-like P (glucose-6-phosphate), and pyrophosphate of bulk molybdate unreactive phosphorus (MUP). First results from the enzymatic assay indicated that monoester-like P and diester-like P were the most prominent form of the hydrolysable DOP constituents. In leachates from the organic layer, there was a high enzymatic activity for monoester-like P, indicating high recycling efficiency and rapid hydrolysis of labile DOP constituents. DOP was the dominating P form in soil solution at some of the sites, with a greater contribution to total dissolved P in winter than in summer. Concentrations of DOP decreased along the phosphorus availability gradient from less to the more developed forest ecosystems.