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The turnover of phosphorus in the soil solution

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The exchange rate of inorganic phosphorus (P) between the soil solution and solid phase, also known as soil solution P turnover, is essential for describing the kinetics of bioavailable P. While soil solution P turnover (Km) can be determined by tracing radioisotopes in a soil solution system, few studies have done so. We believe that this is due to a lack of understanding on how to derive Km from isotopic exchange kinetic (IEK) experiments, a common form of radioisotope dilution study. In this study, we provide a derivation of calculating Km using parameters obtained from IEK experiments. We then calculated Km for 217 soils from published IEK experiments in terrestrial ecosystems, and also that of 18 long-term P fertilizer field experiments. Analysis of the global compilation data set revealed a negative relationship between concentrations of soil solution P and Km. Furthermore, Km buffered isotopically exchangeable P in soils with low concentrations of soil solution P. This finding was supported by an analysis of long-term P fertilizer field experiments, which revealed a negative relationship between Km and phosphate-buffering capacity. Our study provides new insight into the diffusion-based mechanisms of P buffering across a large range of soil types. (This work was recently published in Biogeosciences.)

Helfenstein, J., Jegminat, J., McLaren, T. I., and Frossard, E.: Soil solution phosphorus turnover: derivation, interpretation, and insights from a global compilation of isotope exchange kinetic studies, Biogeosciences, 15, 105-114, https://doi.org/10.5194/bg-15-105-2018, 2018.