MSc project(s) in the group of Plant Nutrition, ETH Zurich

Labile organic matter and polyphosphate from soils for ^{18}O-P studies

The oxygen isotopes ratio in phosphate (^{18}O-P) from the soil solution and/or from the microbial biomass pools has been used in the last years to study phosphorus cycling in soils. It is particularly useful to unravel the role of living organisms and their interaction with the environment, which in turn affect phosphate availability and fate in the ecosystem.
The research and optimization of alternative methods for microbial biomass extraction is key to continue with ^{18}O-P studies in the soil system. Up to present, we have been stuck in using tested and generally accepted approaches, which, however, have several flaws, like:

a. an incomplete extraction of the microbial biomass and a fuzzy differentiation of refractory from labile and fresh biomass. This last most likely constitutes the organic P substrate hydrolysed by enzymes to obtain available inorganic phosphate, and

b. the difficulty of extracting/characterizing polyphosphates, which represent a rarely accounted biologically-mediated source of P, especially in fungi dominated environments. Possible artefacts during the commonly used extractions could give rise to inorganic hydrolysis of polyphosphate and thus incorrect values of ^{18}O-P in the soil solution (as measured with anion exchange resins) and microbial (as measured after fumigation with hexanol and corrected for the resin extractable P) P pools.

The experiments foreseen in this project will tackle either one of the two above-mentioned aspects, and will allow to improve the methodological approach when analysing the ^{18}O-P in soil to study the biological processes affecting P cycling.
In addition, we propose to explore the isotopic effect of acid phosphatase on the hydrolysis of polyphosphates. These compounds are present in managed and natural soils, and are susceptible to hydrolysis either by polyphosphatases and acid phosphatases (Alvarez et al., 2011, Louche et al., 2010). Phosphate released by hydrolysis of polyphosphate might constitute an additional unaccounted source of P to soil solution, and might thus contribute to explain unexpected resin ^{18}O-P observations.

The MSc student will work on the organic horizon of forest soils, collected in the framework of the SPP 1685: Ecosystem Nutrition, Forest Strategies for limited Phosphorus Resources.

The MSc project(s) will be conducted at the ETH Research Station in Eschikon and in collaboration with Dr Chiara Pistocchi, from INRA Montpellier (France).

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