



Using oxygen isotopes for tracing phosphate sources at the catchment level

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In the last 50 years, the use of phosphate and nitrate fertilizers has dramatically increased producing serious environmental consequences and enhancing the consumption of limited resources.

Tracing P has always been a complicated endeavor, since once that P is dissolved as orthophosphate, P derived from different sources (e.g., soil, fertilizer, plant residues) cannot be distinguished one from the other. Due to safety concerns, radioisotopes such as ^{32}P and ^{33}P , are currently used to study the dynamics and transfers of P in the soil and plant system only in laboratory and greenhouse experiments.

P has only one stable isotope (^{31}P), so contrary to nitrogen or carbon or sulfur, a stable isotopes approach was not considered as a possible venue for P studies. For this reason, the research community involved in environmental studies put many hopes into the use of oxygen isotopes in phosphate ($^{18}\text{O-P}$). At present, the main application of oxygen isotopes in the environment is understanding and providing more insights into the biological P cycle, but not tracing fluxes and transfers of P in the environment. This is because enzyme activity, which promotes the exchange of oxygen between phosphate and water, can be so extensive to completely erase a source signal.

Throughout the years, we have collected $^{18}\text{O-P}$ signatures of mineral fertilisers and animal manures with the goal to build a database of P sources to the environment. At the same time, the use of $^{18}\text{O-P}$ for tracing sources of P has been re-evaluated. Under specific conditions, this tracer could be used to identify sources of P and differentiate between transport/transfer of P and biological transformations at the catchment scale.