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Phosphate oxygen isotope analysis to study phosphorous cycling

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Phosphorus (P), which is an essential element for all of life on the earth, often limits the productivity of aquatic ecosystems, especially of freshwater ecosystems, because of its scarcity relative to other macronutrients. In modern society, anthropogenic P loadings have caused serious eutrophication and deteriorated ecosystem services all over the world, stimulating social needs for studies on P cycling. Although identification of the primary P sources can provide useful information for designing the best ecosystem management practices to control eutrophication, standard methods have not yet been established because P-involved chemical processes are complicated and P has only one stable isotope, therefore, P isotope ratio is not available as natural tracers. With traditional P transport models, for instance, we have difficulty in estimating the relative contribution of P loadings from a variety of sources. Recently, however, a new isotopic technique has been developed to measure oxygen isotope ratio of dissolved inorganic phosphate ($\delta^{18}O_P$), which distinguishes different phosphate sources and also reflects the degree of phosphate turnover by organisms. Here we apply this isotopic technique to identify natural and anthropogenic P sources and evaluate its relative importance to biological P recycling in a watershed ecosystem.

Keywords: Temperature-dependent isotope exchange equilibrium, Kinetic isotope fractionation, Thermal conversion/elemental analyzer, Pyrophosphatase, Phosphate oxygen isotope ratio