Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.34332

Migration and Quantitative Source Analysis of Phosphorus using phosphate oxygen isotopes in a typical large catchment

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Phosphorus(P) is part of life activities in the ecosystem; however, excessive P input into watersheds causes major pollution concerns in large catchments. The sources, transformation pathways, and formation mechanisms of Phosphorus remain largely elusive. There is also a lack of quantitative analysis of the main anthropogenic P inputs in each sub-watershed. Therefore, this study aimed to quantitatively identify the proportions of multiple potential end members in a typical large catchment by combining phosphate oxygen isotope, land-use type, mixed end-element model, and a Bayesian model. The $^{18}O_{(PO4)}$ values of river water varied spatially from 6.0‰ to 20.9‰ in the dry season and 4.9‰ to18.3‰ in the wet season. There is a great difference between $^{18}O_{(PO4)}$ and equilibrium fractionation values at all sampling points in the main stream of the Yangtze River; therefore, the phosphate oxygen isotope technique can be effectively used for P tracing. Based on the isotope mass balance calculation and Bayesian model, the contribution rate of external P input in each section of the Yangtze River main stream was quantitatively analyzed. In the wet season, TP content of the Yangtze River main stream is significantly higher than in the dry season. At the watershed scale, the change trend of TP flux and dissolved total P (DTP) flux was opposite, because the interception effect of dams on particulate P is significantly better than DTP. There is a great difference between $^{18}O_{(PO4)}$ and equilibrium fractionation values of all sampling points in the main stream of the YR; therefore, the phosphate oxygen isotope technique can be effectively used for P tracing. Based on isotope mass-balance calculations and a Bayesian model, the contribution rate of external P input in each section of the Yangtze River main stream was quantitatively analyzed. Therefore, it is of great significance to quantitatively analyze the contribution rate of the main external P and evaluate the legacy P pollution load in the YR.