Oxygen isotope composition of inorganic phosphate of typical black soils in China

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Black soil is one of the important soil types in the world, and phosphorus (P) is one of the essential nutrient elements in organism and also important inducement of environmental problems.However, However, there is inadequate information on available P transformation of black soil, and the subsequent soil degeneration problems are serious. The oxygen isotope of phosphate is an effective tool to trace sources and transformation of P in black soil. Here, we analyzed the oxygen isotopic composition of inorganic phosphate ($\delta^{18}O_P$) and phosphate concentration from different fractions (Milli-Q water, 0.5 mol·L^{-1} $NaHCO_3$, 0.1 mol·L^{-1} NaOH and 1 mol·L^{-1} HCl) of agricultural soils from typical black soil area - Gongzhuling in Jilin province. The $\delta^{18}O_P$ values ranged from 13.3‰ to 14.3‰ in the water extracts, from 11.5‰ to 17.9‰ in the $NaHCO_3$ extracts, from 10.2‰ to 13.7‰ in the NaOH extracts, and from 6.2‰ to 8.2‰ in the HCl extracts.

The $\delta^{18}O_P$ values of some $NaHCO_3$ extracts and NaOH extracts were within the predicted $\delta^{18}O_P$ value (11.7‰) in equilibrium with ambient water suggesting that the rapid P cycle and transformation between different P pools were driven by soil microorganisms. The $\delta^{18}O_P$ values of the water extracts, some $NaHCO_3$ extracts and NaOH extracts were above the equilibrium value reflecting the steady state between microbial uptake of phosphate and the release of intracellular phosphate back to the soil. The HCl extracts with the lowest $\delta^{18}O_P$ values were much more stable soil fractions and likely retained the oxygen isotopic signature of the original soil parent materials. These results suggested the oxygen isotope of phosphate could help to better understand the transformations of P in black soil and provide evidence for effective utilization of soil P.

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