Oxygen isotopes in phosphate as a tracer for sources and pathways of catchment P in stream water

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This study aims at investigating the feasibility of using oxygen isotope measurements on dissolved inorganic phosphate (DIP) to quantify the contribution of different sources of P to the DIP transport from small catchments in South Sweden. Recent studies by Elsbury et al. (2009) have proven that δ^{18}Op values can be an efficient tool to study sources and transport pathways for dissolved phosphate.

We present the results from analyses of samples collected from rural sewage septic tanks, drainage wells from agricultural fields on clay soils, stream-bank erosion spots, and the stream water from one catchment with mixed land-use. Sample handling and isotope measurements were done similar to the procedures described by McLaughlin et al. (2004), but adapted to the specific chemistry of the different water types. Samples were shaken with activated carbon powder prior to filtering in order to remove organic matter (modified after Gruau et al. 2005).

The preliminary results show that the septic tank effluents could be clearly distinguished from the drainage water by the δ^{18}Op values of DIP. Depending on the site, the δ^{18}Op varied from +7 to +10 ‰ in the field drainage waters, whereas the sewage samples showed significantly higher δ^{18}Op values of +12 to +14 ‰, all values reported relative to VSMOW. Phosphate in fresh water with low DIP concentrations is expected to be in equilibrium with ambient water (δ^{18}Ow = -16 to -12‰), whereas wastewater contains high concentrations of DIP, is not in equilibrium, and thus reflects the isotope signature of the source.

Focusing on one catchment with mixed landuse, the possible seasonal and flow dependent variations in the isotope ratios of DIP in drainage and stream water is investigated along with sampling of TP and DIP concentrations and water flow measurements. Additionally, the isotopic composition of readily available phosphate in the agricultural soils of the catchment is analyzed. Furthermore, changes in the isotopic composition of stream water DIP caused by sewage discharge are investigated in five small catchments that are not impacted by agriculture. The results from those measurements will be used when modeling the dynamics of phosphorus losses from the studied catchment areas.

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