Copper mass balances and stable isotopes as analytical tool to trace sources and processes in agricultural systems

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In animal husbandary, copper (Cu) is used as feed additive and pharmaceutical. The Cu is tranferred into manure and distributed on agricultural land. Finally, the Cu from the manure can accumulate in agricultural soils. Although being a micronutrient, high Cu concentrations are toxic for microorganisms and invertebrates and endanger the soil fertility. Former studies revealed Cu accumulations in Swiss agricultural soils in the past decades. However, these studies were not completely based on in-situ measured data. The aim of this study was to fill this gap and measure Cu fluxes at selected Swiss agricultural sites. Specifically, the aim was to trace Cu in the soil and to differentiate between anthropogenic and geogenic sources. Additionally, the metal distribution in Swiss agricultural systems was further elucidated, based on stable isotope ratios of system fluxes and soil pools.

For that purpose, Cu balances of three grassland sites were determined by measuring the soil metal concentrations and all inputs (atmospheric bulk deposition, manure & parent material) and outputs (seepage water and grass harvest) during one hydrological year (May 2014 – May 2015). Furthermore, stable Cu isotope compositions of the soil and all inputs will be measured.

Cu mass balances showed net accumulations at all three sites (25-209 g ha^{-1} yr^{-1}) and manure application was the most important flux (146-340 g ha^{-1} yr^{-1}). Inputs with bulk deposition and through parent material weathering were by 1-2 orders of magnitude smaller. Beside the Cu budgets, stable isotope data (not yet analysed) will be presented and discussed to assess the biogeochemical processes and redistribution of (anthropogenic) Cu in agricultural systems.

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