Magnesium isotope signatures in long-term arable field trials in Germany

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Magnesium (Mg) is the fourth most abundant element in the earth and widely distributed in the silicate earth, hydrosphere and biosphere. Moreover, Mg is one of the macro essential elements for most plants and of great importance to biological functions. With the increasing use of non-traditional stable isotopes systems, isotope fractionations in $^{26}Mg/^{24}Mg$ have been observed in many geological and biological processes. Analyses of Mg isotopes could be an innovative and powerful tool to elucidate the biogeochemical cycle of Mg in natural ecosystems. However, to date most investigations of Mg isotope fractionation are centered in geologic studies. Studies of Mg isotope fractionation in agriculture soil-plant systems have so far not been reported. In this study, we present for the first time Mg isotope signatures in soil profiles from anthropogenically impacted arable fields in Germany. Effect of long-term soil management was assessed by analysing the Mg isotope compositions in soil. The soil $\delta^{26}Mg$ compositions showed that the isotopic ratio $^{26}Mg/^{24}Mg$ increased along with soil profile, indicating a depletion of heavier Mg in the topsoil while compared with heavier Mg accumulation in the subsoil. Magnesium in the no-liming fields was found isotopically lighter than that in liming fields across all depths, which highlighted positive response to the soil managements. Thus, the isotope signature could potentially yield significant information on elemental transports in soils and help to clarify important nutrients uptake processes by crops. We aim to explore that to what extent the Mg isotope compositions in soil-plant systems could be affected by plants as well as some other long-term soil managements, through which we could illuminate these Mg isotope data as an indicator of nutrient use efficiency by plants from different soil depth. Therefore, Mg isotope fractionations that occurred during the whole process including nutrient uptake and transport inside plant under various soil conditions would be explored.