



Mg-isotope fractionation in a karst system: Field experiments at Bunker Cave (Germany)

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At present, only a limited number of Magnesium-isotopic data from continental weathering systems exist. This is noteworthy, as Magnesium is one of the most abundant elements in the continental crust as well as in the oceans and in hydrological and biological systems. Here we focus on Mg isotope fractionation in cave systems. Magnesium-isotope fractionation in speleothems is dependent on (1) the weathering rates of soil and hostrock, (2) the changes in silicate versus carbonate weathering ratios, (3) the groundwater residence time and (4) the precipitation rates of calcite in speleothems. In order to analyse the Mg-isotopic composition through a karst system, the well monitored Bunker Cave in NW Germany was used. The Mg-isotope composition of soil water, four different drip water sites and of recent calcite precipitates, collected from four different watch glasses, were analyzed using MC-ICP-MS. The soil water shows the heaviest isotopic composition ($-0.51 \pm 0.1\text{‰}$), followed by lighter values of drip waters (TS 1: $-1.53 \pm 0.07\text{‰}$ TS2 : $-1.69 \pm 0.03\text{‰}$ TS3 : $-1.68 \pm 0.04\text{‰}$ TS8 : $-1.68 \pm 0.06\text{‰}$ and recent calcite precipitates (U I: $-3.20 \pm 0.54\text{‰}$ U III : $-3.81 \pm 0.15\text{‰}$ U VII : $-3.63 \pm 0.42\text{‰}$ U IV : $-3.61 \pm 0.24\text{‰}$). Drip water from experimental site TS 1 has a heavier isotopic composition compared with the other drip waters. Furthermore the calcite from watch glass U I also show a heavier isotopic composition than the other calcite precipitates. The drip water TS 1 displays the same trend in the Mg-isotopic composition over time as soil water shows. The soil water is a mixture of the Mg-isotopic compositions of the rain water and the soil $\delta^{26}\text{Mg}$. The variations in the soil and drip water (TS 1) show the changes in silicate vs. carbonate weathering ratios, which are temperature and precipitation (rain) dependent. The other drip waters (TS 2, TS 3 & TS 8) have a longer residence time in the hostrock than TS 1 and therefore do not show this trend, because of an offset and reduction of this signal. This is due to their drip characteristics which differ from TS 1. In the recent calcite precipitates the Mg-isotopic composition depends strongly on the growth rate. The $\delta^{26}\text{Mg}$ -values are lighter at a higher growth rate and vice versa. The climatic signal, which is shown by the Mg- isotopic composition in the water, is affected by the growth rate. This means that the Mg-isotopic composition of the calcite is much stronger influenced by the growth rate than by the changes of the silicate vs. carbonate weathering ratio.