K and Ca isotopic fractionation by plants

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Geochemical cycling of metals includes the weathering of silicate rocks and the release of dissolved constitutes into rivers and eventually the oceans. Some metals (e.g. Mg, Ca, K, Fe, Zn) are important nutrients for plants, thus plants can accelerate rock weathering to obtain them, and therefore represent a significant reservoir in the geochemical cycle. In such a context, Ca cycling has been investigated through Ca isotopic analyses, indicating a preferential uptake of ^{40}Ca relative to ^{44}Ca by plants and an enrichment in heavy Ca isotopes in the soil pore water (e.g. [1]). The differentiated Ca isotopic compositions among different plant organs have been detailed in more recent work [2]. In the case of K, it has been suggested that terrestrial plants represent a significant reservoir for K, with as much as 40-70% or more of the dissolved K in the world's rivers coming from the decay of plant matter [3], resulting from its crucial role as a plant nutrient. Therefore, potassium isotopic systematics potentially provides a new tool for tracking and quantifying nutrient cycling in ecological systems (e.g. boreal vs. tropical forests) and a proxy for global geochemical cycling.

We have conducted experiments involving three species of hydroponically grown vascular plants (wheat, bean, rice) to study K isotopic fractionation behavior during uptake and transport through growing plants. Our K isotopic data from these experiments demonstrate for the first time, K isotopic fractionation by plants. Our data indicate that plants sequester isotopically light K, with a pattern comparable to our measured pattern for Ca isotopes: roots are isotopically lighter than the hydroponic solution, leaves lighter than roots, and stems the lightest. Our Ca isotopic data are consistent with the experimental data for Ca isotopic fractionation in plants by [2]. Comparing our observed fractionation of K to that of the Ca in the same samples, suggests that on a per amu basis, the isotopic fractionation of K by plants is about twice that of Ca.

[1] Wiegand *et al* (2005) *Geophys. Res. Lett.* **32**, L11404 [2] Cobert *et al* (2011) *Geochim. Cosmochim. Acta* **75**, 5467-5482 [3] Chaudhuri *et al* (2007) *Chem. Geol.* **243**, 178-190