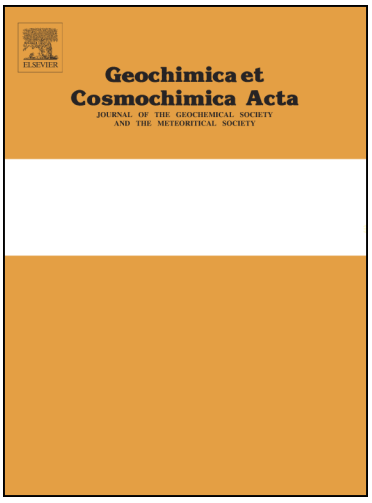

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Sara R. Kimmig, Chris Holmden, Nicolas Bélanger

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Biogeochemical cycling of Mg and its isotopes in a sugar maple forest in Québec

Sara R. Kimmig[a†], Chris Holmden[a] and Nicolas Bélanger[b]

[a] Saskatchewan Isotope Laboratory, Department of Geological Sciences, University of Saskatchewan, 114 Science Place, Saskatoon SK, S7N 5E2, Canada

[b] Département science et technologie, Université TÉLUQ, 5800, rue Saint-Denis, bureau 1105, Montréal QC, H2S 3L5, Canada

[†]Present Address: Biodiversity Institute, University of Kansas, Lawrence, KS 66045, USA

0. Abstract

A Mg isotope study of sugar maple (*Acer saccharum* Marsh.) in a field site in southern Québec, Canada, and seedlings grown in sterile soil substrate in the laboratory, both demonstrate per mil level within-tree Mg isotope fractionation. However, only sugar maple seedlings grown in the laboratory fractionate Mg isotopes during uptake into fine roots, favoring heavy isotope enrichment in the plant compared to the growth medium. Absence of uptake-related Mg isotope fractionation in field stands of sugar maple is tentatively attributed to the activities of the arbuscular mycorrhizal fungi that colonize fine roots of the trees in the field, but were absent from the laboratory grown specimens. The fungi facilitate nutrient uptake for the tree, while the tree provides valuable carbohydrates to the fungi. Without the symbiotic fungi, pot-grown trees in the laboratory are visibly stressed and often die. The mechanisms responsible for Mg isotopic fractionation in stressed trees remains to be elucidated. Rivers are isotopically light compared to bedrock weathering sources of Mg, and this has bearing on the δ^{26}Mg value of the continental weathering flux of Mg to the oceans, which is an important parameter in studies of ocean Mg cycling in the geological past. If uptake-related fractionation is negligible in many other naturally growing tree species, as it is in sugar maple, then forest growth will exert little or no influence on the δ^{26}Mg value of the export flux of Mg to first-order streams and rivers, and in turn the ocean Mg cycle. Above the tree line, preferential retention of heavy Mg isotopes in clay minerals formed during silicate weathering has been linked to the low δ^{26}Mg values in rivers. In the forested catchment of this study there is no clear evidence for these effects. The 1N HNO_3 leach of the Bf-BC and C mineral soils, which are often used to identify minerals that may be releasing Mg and other base cations to plant-available pools, have the same average δ^{26}Mg value (–0.66‰, n=2) as the litter layer and exchangeable leach of the forest floor, all soil solutions, and the