Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10387, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10387
EGU General Assembly 2008

Lithium isotope fractionations: Evidence from Li concentrations and isotopic compositions of waters, rocks and soils in the Strengbach catchment (Vosges, France)

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Lithium isotopic composition of rocks, soils and continental waters has been shown to be an interesting proxy of continental weathering mechanisms, but this use requires a good knowledge of the origin of its isotopic fractionation. The aim of this study is to better constrain Li isotopes fractionations during weathering by studying variations of Li concentrations and isotopic compositions at the scale of a small granitic watershed (Strengbach catchment, Vosges, France, http://ohge.u-strasbg.fr). Samples of precipitations, springs, stream waters and soil solutions have been collected during 2 years for Li concentration and isotopic measurements. The results show the following main points:

- At the basin scale, Li isotopic compositions of springs and stream waters are quite variable but always heavier than Li isotopic composition of soils and parent rock. Ratios TZ^+/Li ($TZ^+=Na^+ + K^+ + 2Ca^{2+} + 2Mg^{2+}$) is also systematically higher in waters than in soils and parent rock. Moreover, at low discharge, Li isotopic composition increases with decreasing altitude and decreasing Li concentration. This strongly suggests a preferential uptake of light Li occurring during water interaction with rocks and soils (adsorption or coprecipitation in secondary minerals).

- When discharge increases, δ^7Li and TZ^+/Li of outlet waters decrease. This probably signifies that contact time between waters and minerals has decrease allowing less uptake of light lithium but the contribution of soil solutions with low Li isotopic compositions and low TZ^+/Li can also be involved.

- Li concentrations and isotopic ratios (δ^7Li) display the greatest range of variations in soil solutions. We could show that these variations are related to secondary clays dissolution in the upper horizons of the soil, and to coprecipitation with secondary mineralss in deepest horizons.

This study shows the interest of lithium isotopes to trace water rock interactions at the catchment scale and precipitation/dissolution mechanisms in soils.