B isotopes in plant tissues reveal the dynamics of soil/plant exchanges

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In forest ecosystems, B inputs from atmospheric deposits and soil mineral weathering partition between new secondary minerals in soil, drainage waters and new plant tissues. A review of B isotope data in these different ecosystem compartments yields intringuing large isotopic fractionation, in particular between plant tissues and their B sources while no isotopic fractionation is evidenced during B uptake by plant roots [1]. The origins of the isotopic fractionation have to be found during the B transfer from old to young tissues and the parallel partition between the perennial (wood) and ephemeral (leaves) biomass. A recent thorough investigation of B isotopes in two beech tree plots (soil, pore waters, throughfalls, stemfow, roots, trunk wood, trunk bark, large, medium and small branches as well as leaves) developped on two different soils in the Montiers forest (France), evidenced significant inter- and intra-isotopic variations between these different compartments of the soil/plant ecosystem [2]. This indicates that the distribution of B isotopes between plant tissues may reveal mechanisms of plant adaptation to the environmental conditions.

In the present work, we developed a numerical model to describe the B biological cycle and intended to determine the environmental controls and parameters that drive the B isotopic composition of the different plant tissues. The model was calibrated to reproduce the B stocks, fluxes and isotope observed in the beech tree plots developped on two different type of soils, a deep acid soil (alocrisol) with a large pool of bioavailable B and a shallow calcareous soil (rendisol) with a reduced pool of bioavalaible B [2]. The model results emphasize 1) the role of the B transfer from older to younger plant tissues to explain intra-tree variations and 2) the distribution between perennial and ephemeral biomasse to explain inter-tree variations. A link is made between these physiological differences and the B availability in soil. Taken further, we propose to use the B isotopic fractionation between tree leaves and soil minerals as a proxy of the global dynamics of soil/plant exchanges of matter.

[1] Cividini et al (2010), From biological to lithological control of the B geochemical cycle in a forest watershed (Strengbach, Vosges). *Geochimica Et Cosmochimica Acta*, *74*(11), 3143–3163.
[2] Roux et al (2016), The biogeochemical cycle of B and $\delta^{11}B$ in a forest ecosystem, Goldschmidt Conference, Yokohama, Japan