Regional control over B concentration and $\delta^{11}B$ atmospheric input

P. ROUX*[12], M-P. TURPAULT[1], P-O. REDON[3] AND D. LEMARCHAND[2]

[1]BEF-INRA, Centre de Nancy, 54280 Champenoux, France (*correspondence : philippe.roux@nancy.inra.fr)

[2]LHyGeS/CNRS, Université de Strasbourg, France (lemarcha@unistra.fr)

[3]Andra, Centre de Meuse/Haute-Marne, 55290 Bure, France

Boron concentration and isotopic composition ($\delta^{11}B$) of atmospheric inputs (openfield dust and total dissolved depositions) were studied for the first time over a two-year period (2012-2013) to determine the budgets, sources and processes controlling the atmospheric contribution of boron in a forest ecosystem. Boron concentrations in dust depositions (Du) show very high B concentrations ranging from 191 $\mu g.g^{-1}$ to 501 $\mu g.g^{-1}$ while most of total dissolved depositions (TDi) ranges from 1.1 $ng.mL^{-1}$ to 3.6 $ng.mL^{-1}$ with an extreme event at 9.1 ppb during the summer of 2013. $\delta^{11}B$ show a large range of variations, from -4.7 ‰ to +11.4 ‰ for Du and from 8.3 ‰ to 36.6 ‰ for TDi. The measured concentrations yield an annual boron flux of about 10 $mg.ha^{-1}.yr^{-1}$ for Du and about 16 $mg.ha^{-1}.yr^{-1}$ for TDi.

Du data show no clear relationship between B and major or trace elements but the unexpected and rather constant high B concentrations observed over the sampling period indicate a control by one or more B-rich sources, yet to be determined. The $\delta^{11}B$ vs. 1/B mixing diagram evidences the contribution of at least three components. B analyses of some of the fertilizers spread in the nearby agricultural soils and samples of top soil fine particules will allow testing the hypothesis of a regional origin of Du in relation with agricultural activities.

$\delta^{11}B$ data in TDi show a clear seasonal cyclicity throughout the sampling period and are characterized by a high isotopic signature during the summer and a low isotopic signature during the winter. However, the B concentrations remain roughly stable without clear seasonal cyclicity. The observed high isotopic ratios are not associated with a high seawater contribution (according to Na) as classically proposed. This indicates that marine-derived particles unlikely control dissolved boron in our ecosystem. Furthermore, no clear relationship is observed between B, $\delta^{11}B$ and the dissolved major elements, evidencing no major source contribution. We hypothesize that dissolved boron mostly originates from condensated gaseous boron. Evaporation/condensation processes appear therefore to be controlled by local physical atmospheric parameters.