



Can the soil properties affect the O and H isotopic composition of the soil water?

Christophe Hissler (1), Arnaud Legout (2), François Barnich (1), Martine Stoll (1), and Julian Klaus (1)

(1) GEOSAT/EVA/CRP – GL, Belvaux, Luxembourg, (2) BEF/INRA - UR 1138, Champenoux, France

Understanding the dynamic of the soil water content is of primary importance since it is the vector of the matter exchange between soil and the other compartments of watersheds. The soil water is the phase, which is best suited to characterize the current dynamics in the soil and to provide information on mid- to long-term soil processes. Oxygen and Hydrogen stable isotopes of water are now currently used in hydrological studies to inform on water mixing and residence time in the soil and greatly contribute to improve our understanding of soil-water interactions. However, as of today the influence of biogeochemical processes on the spatio-temporal variability of $\delta^{18}\text{O}$ and δD of the soil solutions was rarely quantified. The Oxygen and Hydrogen exchanges between the soil water and the other soil compartments (living organisms, mineral, exchange capacity, organic matter) are still poorly studied and require deeper investigations. For instance, the weathering of silicate minerals produces O_2^- in the soil solution, exchange capacity in acidic soils releases quantity of H^+ in the soil solution and the degradation of the organic matter could also impact the Oxygen and Hydrogen isotope ratios of the soil water. But, are we able to quantify the contribution of these different processes to the Oxygen and Hydrogen isotopic composition of the soil water?

In order to address this question, we set up a laboratory experiment with one liter soil columns of a 2mm-sieved and air-dried soil. The goal of the experiment was to observe the variation of the water Oxygen and Hydrogen isotopic composition at two different depths of these soil columns starting from the field capacity to the complete drying of the soil. Water with a known isotopic composition was used to saturate the soil matrix and we observed the deviation from this initial composition at the different depths during the drying of the soil using ceramic cup lysimeters. Three steps of saturation were applied during the entire experiment. The deviation from the initial isotopic composition becomes significant in the soil waters at the different depths after two weeks of experiment and increases until reaching a threshold at the end of the experiment. After each new saturation step, the isotopic composition of the input water is not conserved anymore in the collected solutions and increases instantaneously. This observation may illustrate the potential for the soil bio-physico-chemical activities to contribute to the O and H composition of the soil water.

These preliminary results allowed us to evaluate the contribution of the evaporation process in the Oxygen and Hydrogen isotopic fractionation and to deduce the potential contribution of soil compartments.