



# Xylem water in *Fagus sylvatica* L.: a multi-isotopes study

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## INTRODUCTION

Stable isotopes of water have been largely used as tracers in ecohydrology, contributing enormously to the development of various hypotheses and interpretations on tree water uptake dynamics and evapo-transpiration fluxes. However, many issues remain when using O-H stable isotopes to trace the origin of the tree water uptake. The lack of standard protocols for tree water sampling and analysis, alongside the little attention given to the effect that tree physiology and biochemistry may have on the isotopic composition of xylem water, is a limitation to the use of these tracers in the regolith-tree continuum.

## OBJECTIVE

- New functional proposition when sap moves up in trees from O and H extraction technique comparisons
- Introducing Pb isotopes as complementary tracer in ecohydrology

## METHODOLOGY

- Three locations in the Weierbach Experimental Catchment in Luxembourg:
  - plateau
  - hillslope
  - riparian area
- Sampling strategy using 3 *Fagus Sylvatica* per site:
  - drilling in the big root and in the bole
  - vacuum pump to collect liquid sap from the same hole (ISVE)
  - <https://doi.org/10.1002/eco.2582>
  - cryogenic extraction on the wood core (CRYO)
- O and H isotope analysis on CRYO and ISVE samples
  - Picarro L2140-I with combustion module
  - precision:  $\delta^{18}\text{O}$  (0.05‰)  $\delta^2\text{H}$  (0.7‰)
- $^{204}\text{Pb}$ ,  $^{206}\text{Pb}$ ,  $^{208}\text{Pb}$  analysis on ISVE samples
  - acid mineralization
  - Pb extraction chromatography on Eichrom Sr Spec and Ln Spec resins
  - Neptune-Thermo-Scientific multicollector (MC-ICP-MS) under dry plasma conditions using a membrane desolvator (APEX, CPI international)
  - NBS 981 standard used to validate the chromatographic separation and isotope measurements

## RESULTS

### 1. In situ sap sampling vs. cryogenic extraction

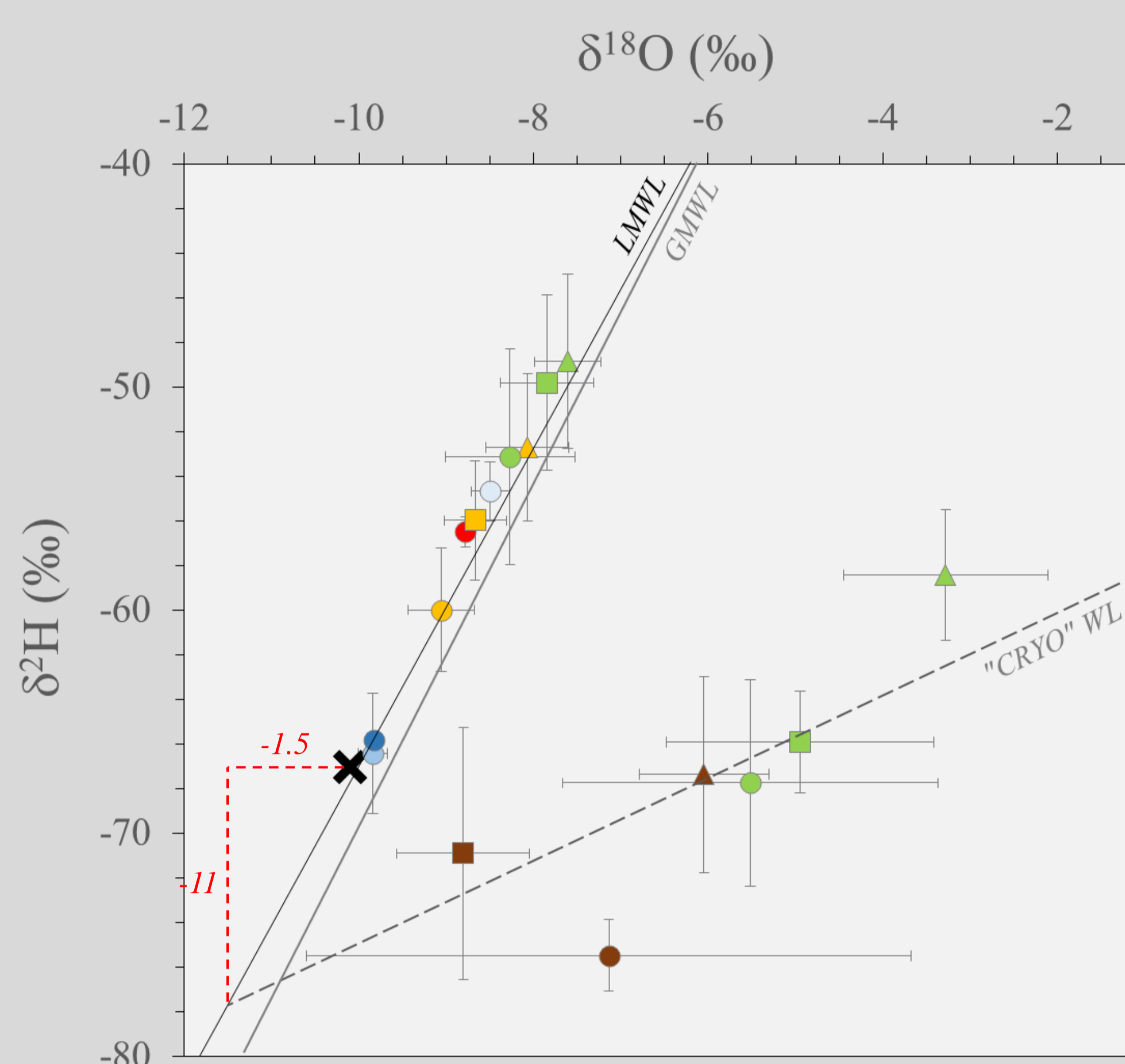


Figure 1: O and H isotopic compositions for all sample types collected during the study.

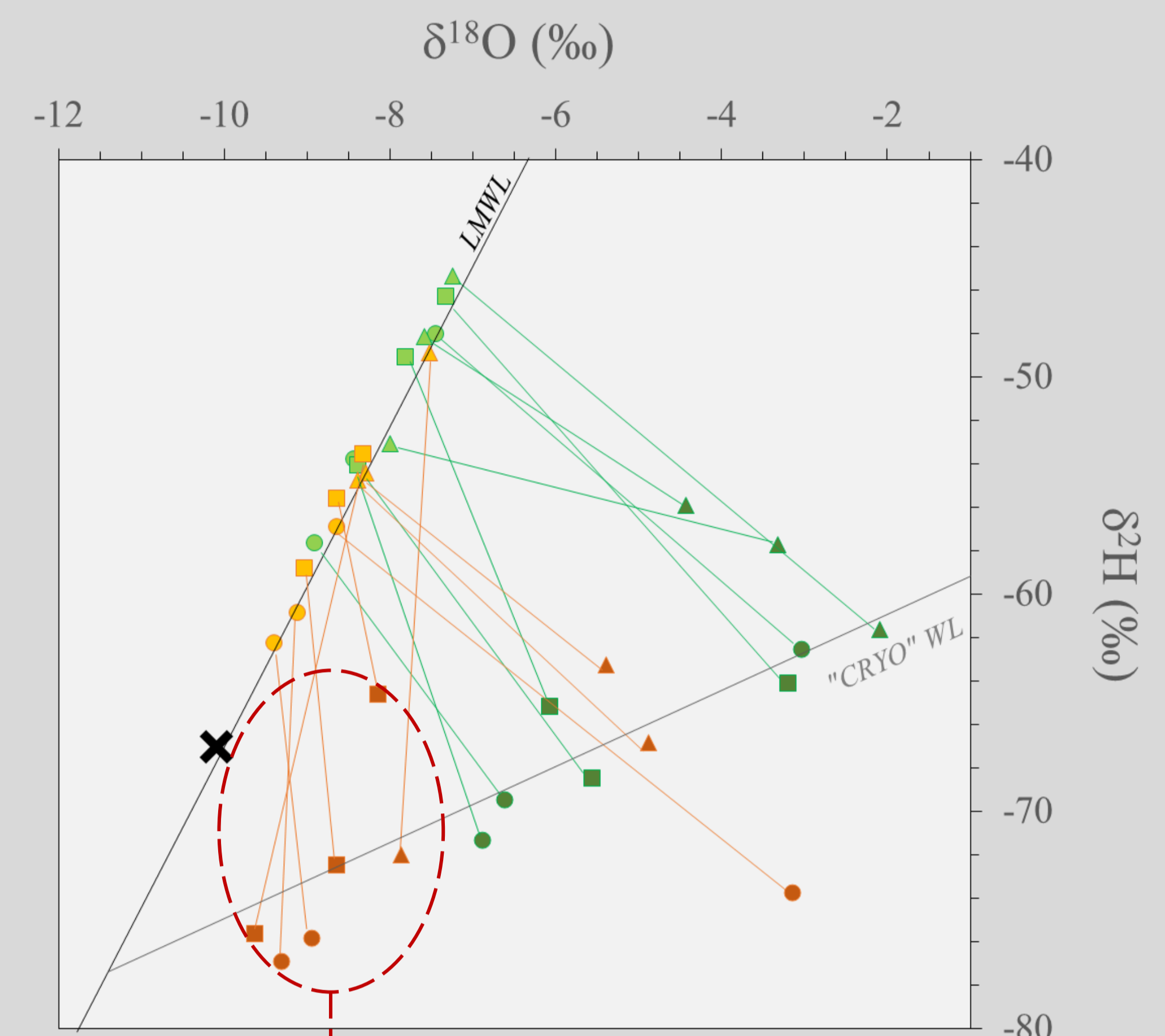


Figure 2: Comparison of the sap isotopic composition between ISVE and CRYO methodologies.

RS_Δ <sup>18</sup> O	TS_Δ <sup>18</sup> O	
0.5	2.3	plateau
0.4	2.8	hillslope
2.9	4.7	riparian

### 2. Insight from Pb radiogenic isotopes

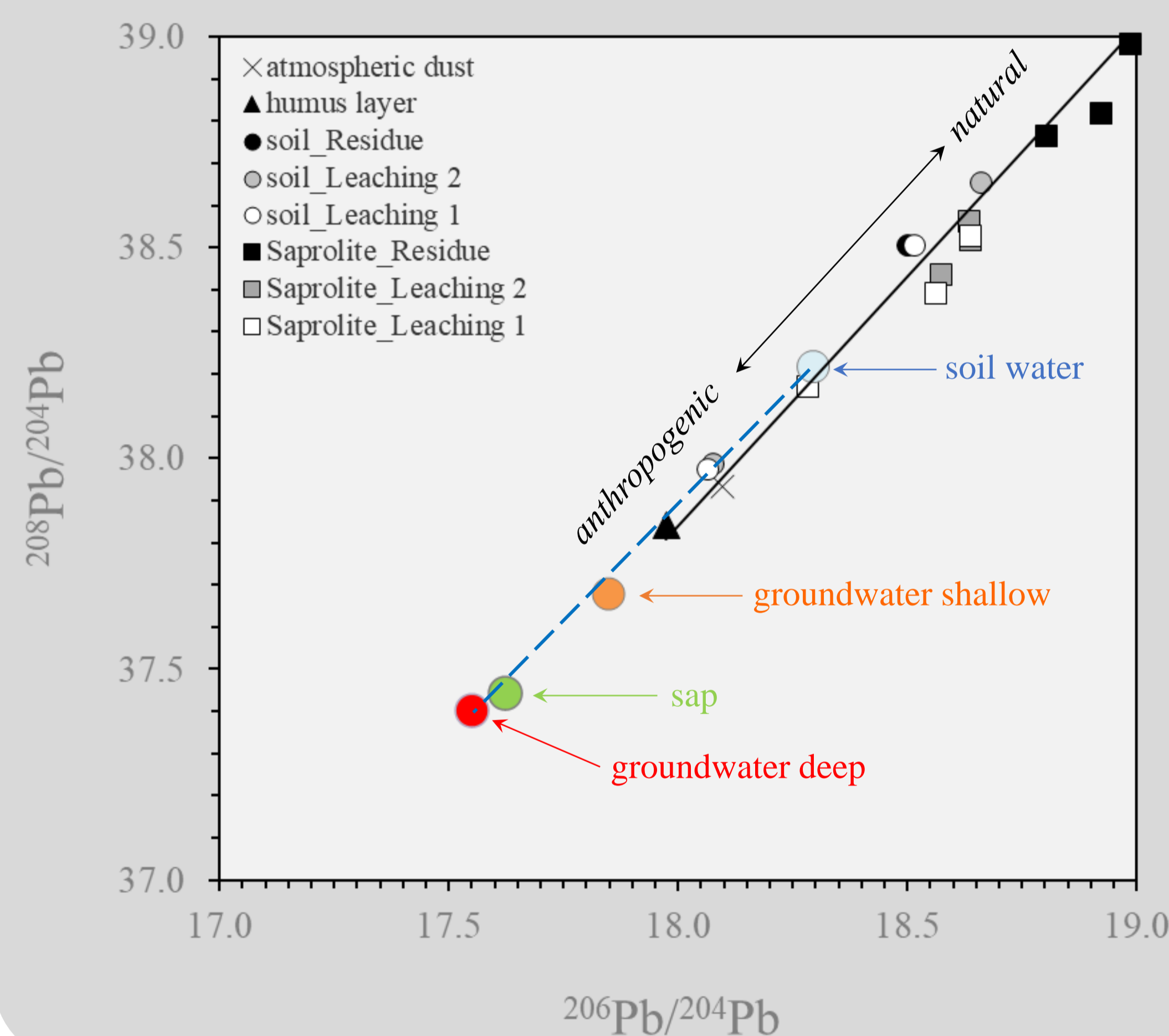


Figure 3: Variation of the radiogenic Pb isotopic composition in the regolith material (white, dark and grey symbols) and in the water collected in this study (colored symbols) in the different compartments of the Weierbach Experimental Catchment.

## CONCLUSION

- Toward direct sampling of tree sap
  - ➔ **CRYO** indicates similar bias as observed in the literature + different values for root and bole samples + low coherence between the sampling sites
  - ➔ **ISVE** indicates root sap isotopic composition closer to water source + progressive enrichment in heavy O and H isotopes + better coherence between the sampling sites
  - ➔ **ISVE vs. CRYO** roots present reduced O fractionation
- new hypothesis when sap is moving up: mixing water of different ages and/or active interactions along the pathway**
- Pb radiogenic isotopes as potential tracer in ecohydrology
  - ➔ Pb radiogenic isotopes are conservative regarding source tracing
  - ➔ the waters follow the mixing line defined for the regolith materials + present a large contrast in Pb isotopic signature
  - ➔ sap contains most of the Pb originated from reservoir connected to the deep groundwater