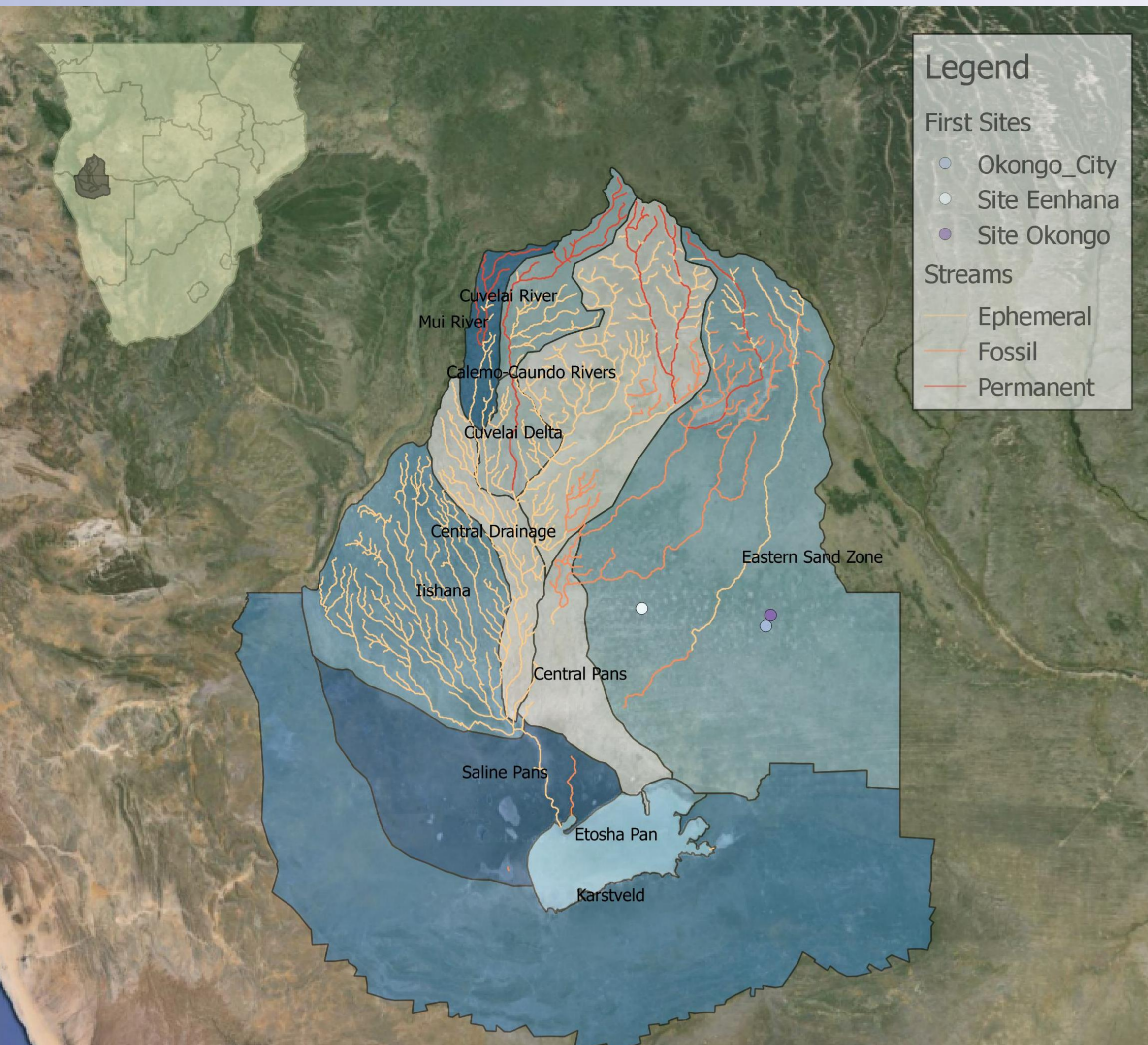


# Recharge estimation in a semi-arid environment using stable isotope methods: A discussion on in-situ field and laboratory techniques.

Marcel Gaj\*, Matthias Beyer, Paul Koeniger, Josefina Hamutoko, Amani Mahindawansa, Heike Wanke, Christoph Kuells, Thomas Himmelsbach



## 1. Introduction:

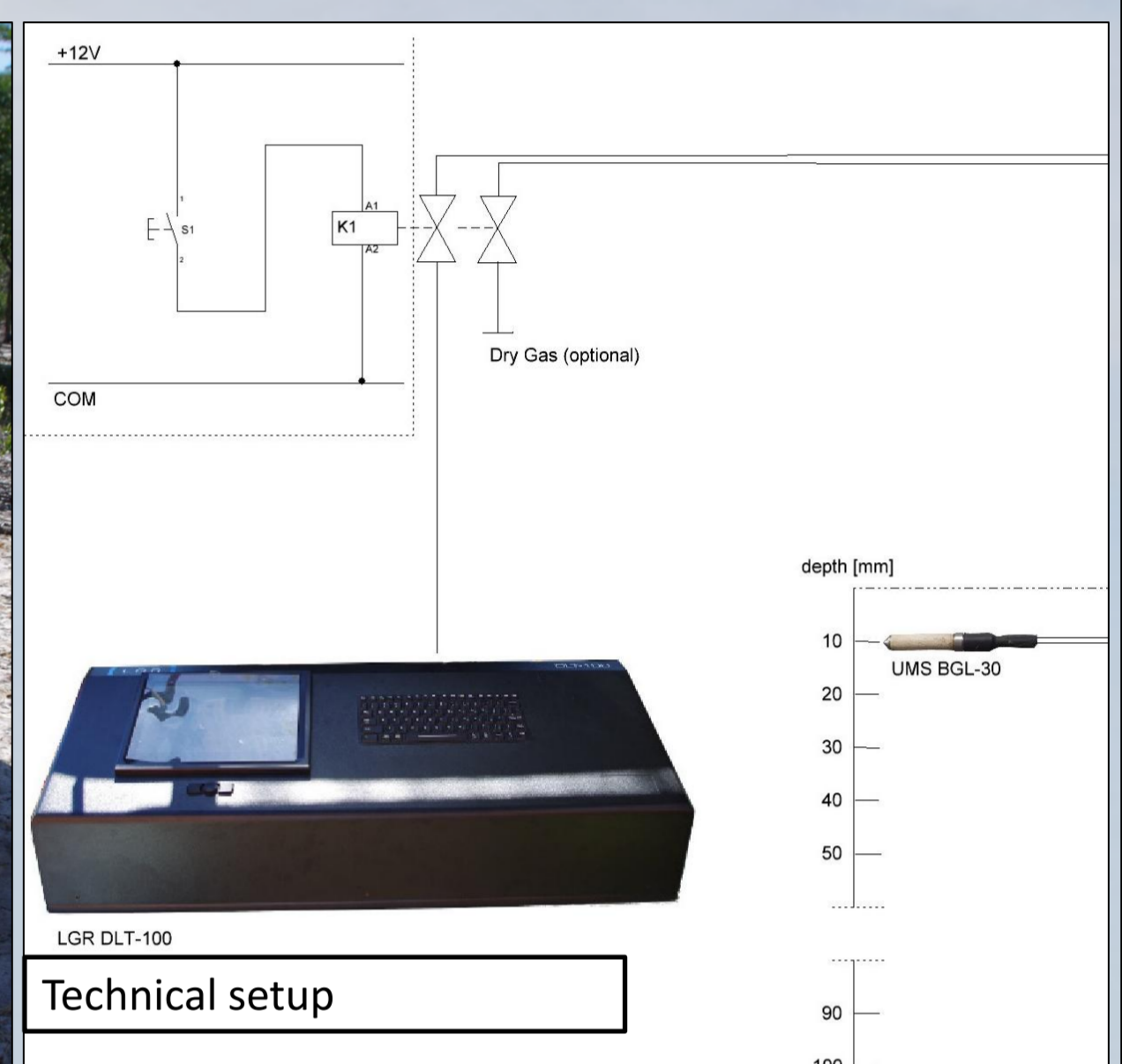
Stable Isotopes of water are powerful proxies for the description of water fluxes such as infiltration, evapotranspiration and plant water uptake in a natural water resource system. Especially the measurement of soil pore water provides information on soil hydraulic properties and interactions within the soil-plant-atmosphere-interface. To gather such information advanced techniques are required to either extract the soil pore water or to equilibrate the soil sample with dry gas at fixed temperatures. Recent development of laser spectrometry even allow to measure the stable isotopologues directly in the field.

These methods can lead to different results and might even not be comparable for the same set of samples. Hence the following questions arise:

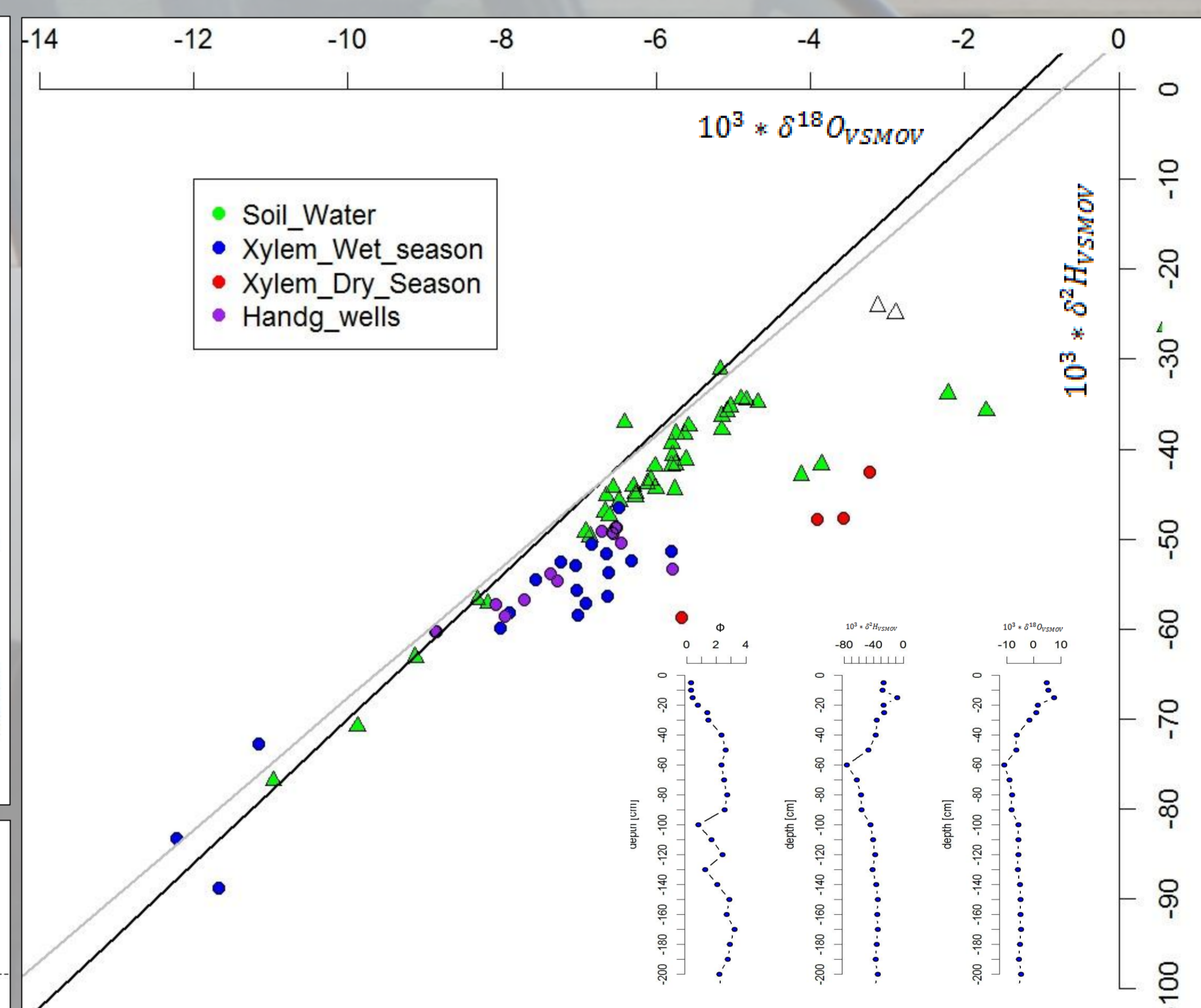
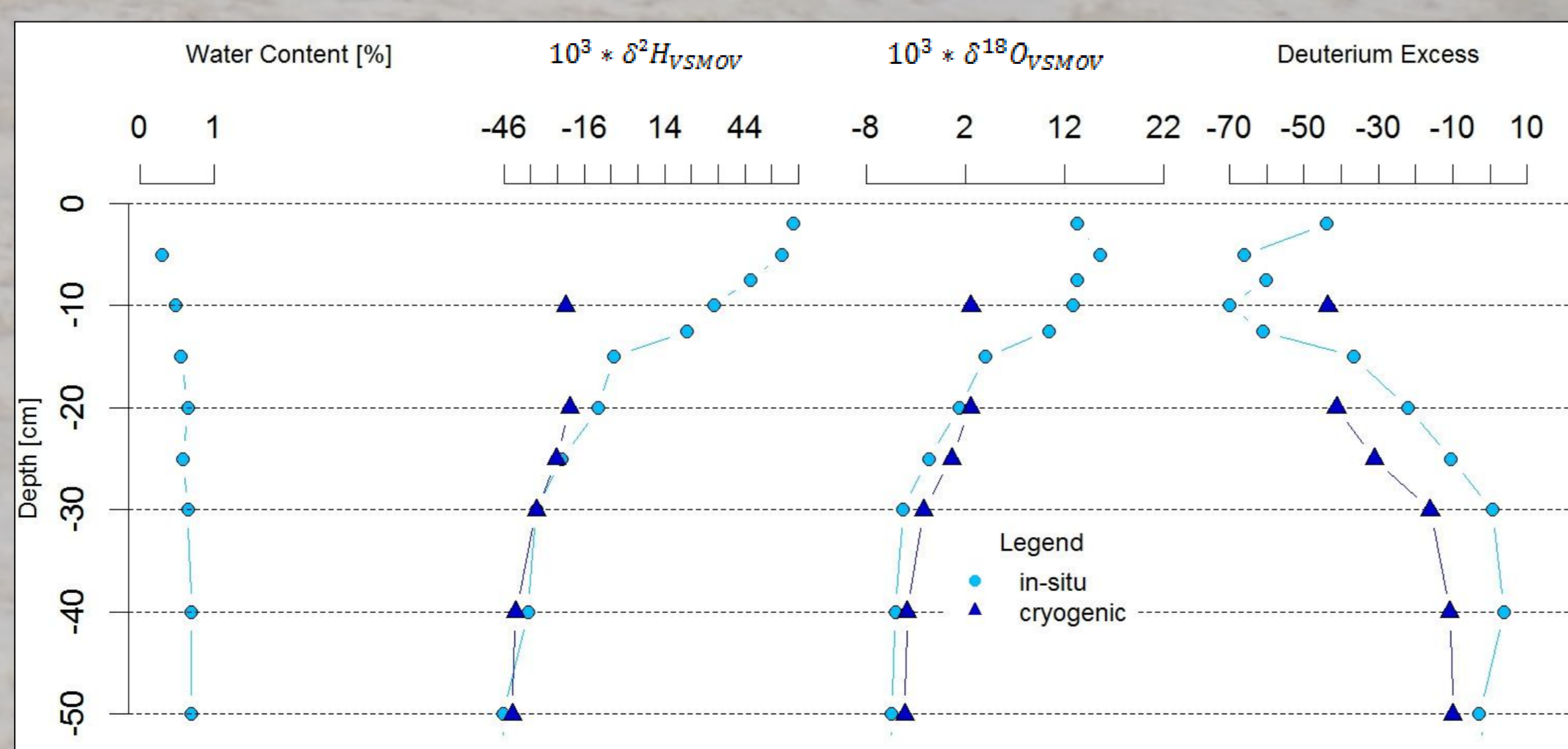
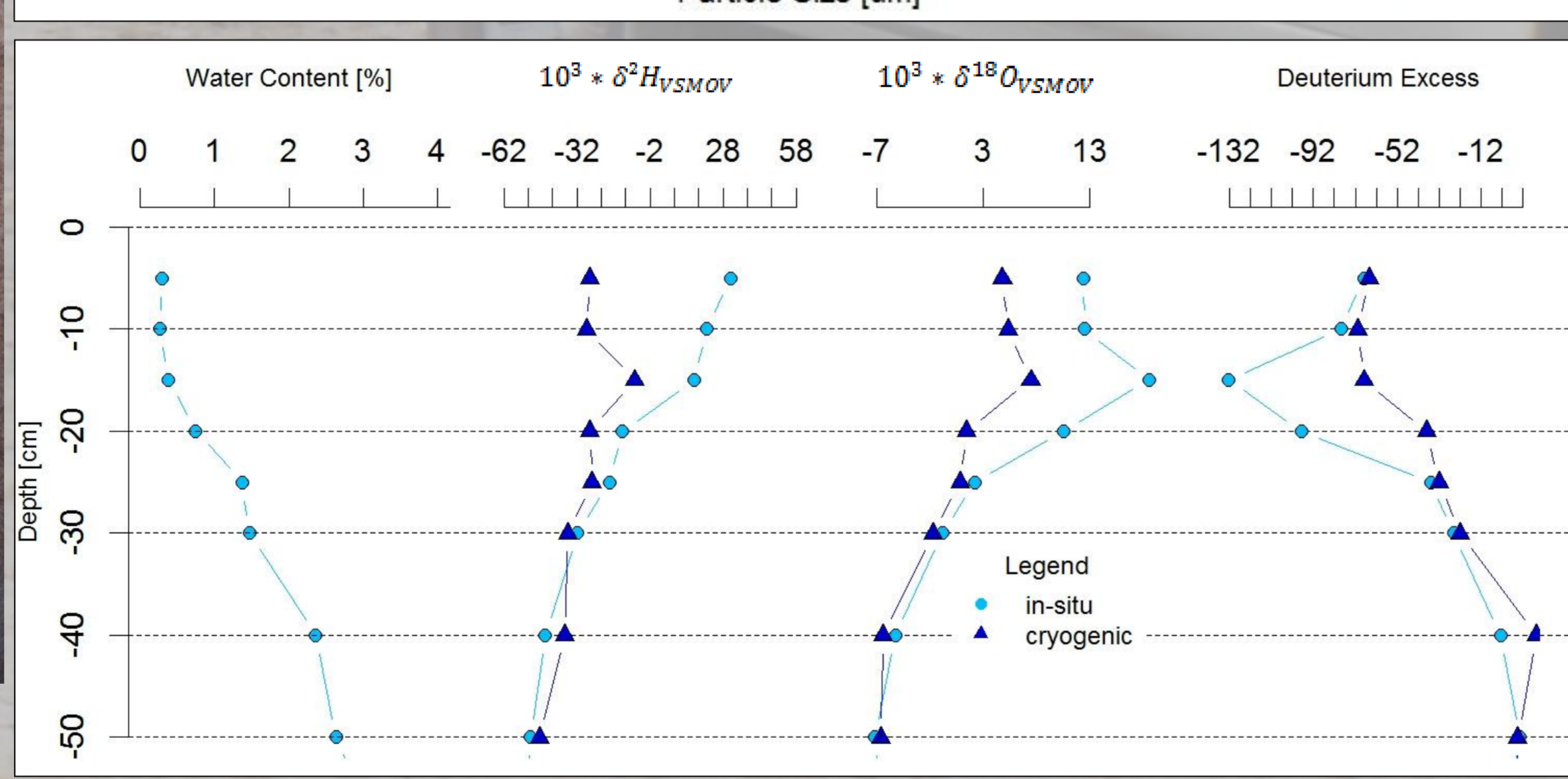
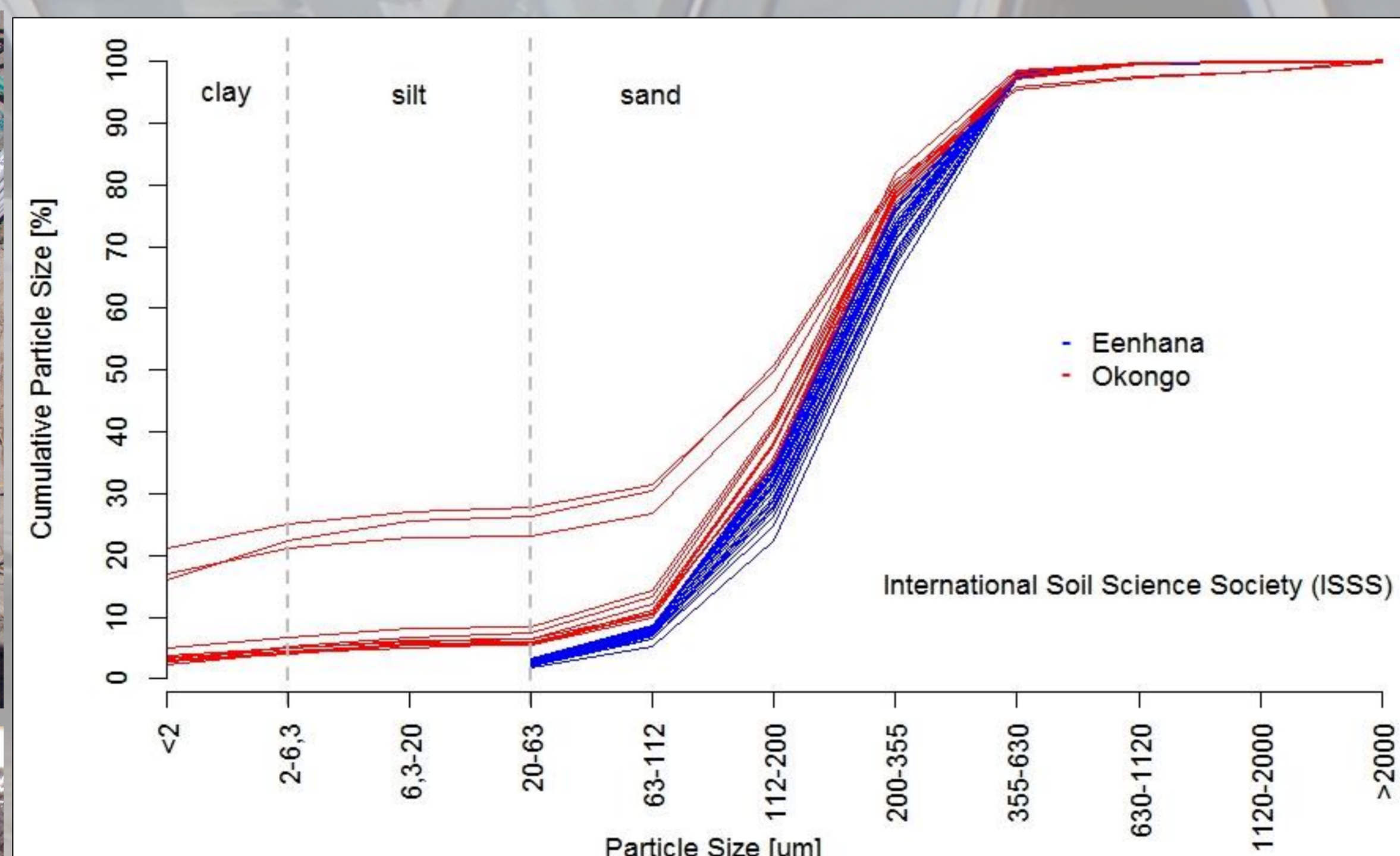
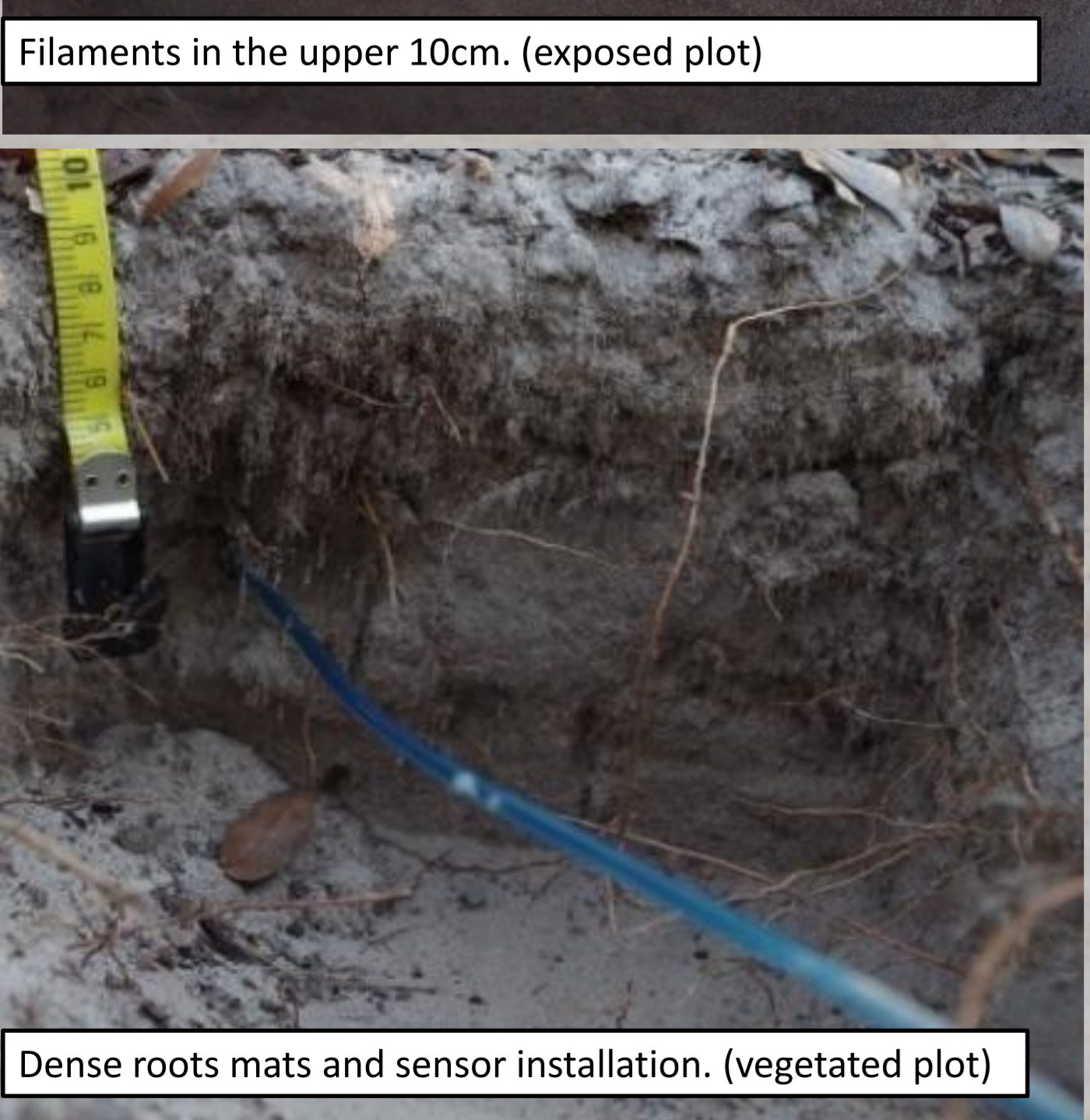
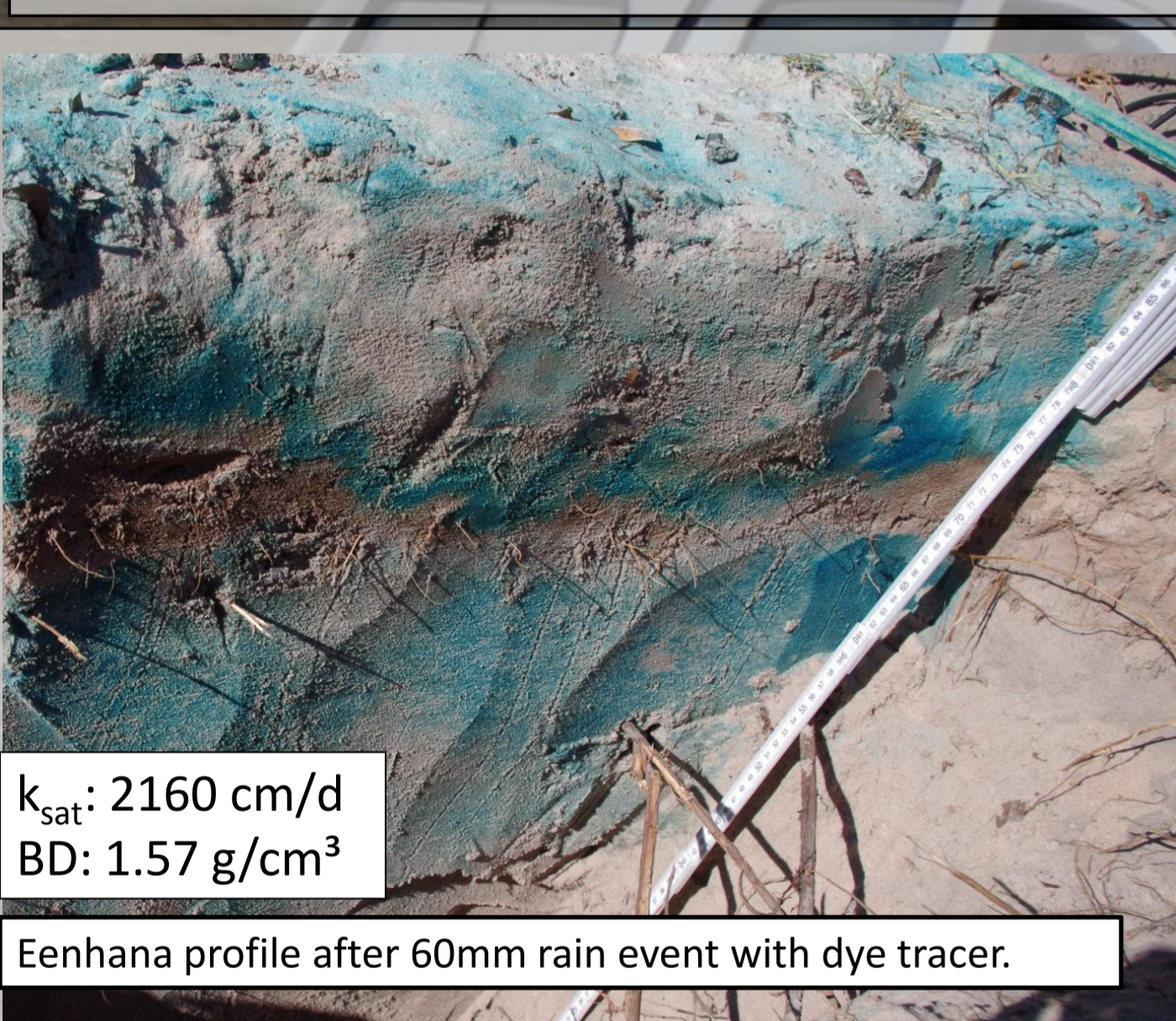
What kind of soil pore water do we actually measure with a particular method?  
 Is there one method performing best or each answering a different question?

In this study an in-situ field method is compared to a common sampling strategy and a modified version of the cryogenic vacuum extraction (Koeniger et. al. 2010) to determine the isotopologues in soil pore water. Further implication of root water uptake are made from a deep isotope profile and plant water extracted from xylem samples.

## 2. Methods:



## 3. Results:



Implications for seasonal water uptake.

## 4. Discussion:

In situ measurements correlate to values derived with sampling and cryogenic-vacuum-extraction for the lower part of the soil profile (25 – 50cm) even for low water contents. However, they diverge for the upper part. Reason might be:  
 → In situ measurements collected during day time  
 → Samples collected in the evening  
 → High interaction with atmospheric water vapor!?

Plant water sources after the wet season do not correspond to soil water, but to shallow groundwater.  
 → groundwater utilization?

Plant water sources after the dry season are more enriched than after the wet season.  
 → Evaporation down to lower parts of the soil profile?

Soil profile is enriched between 0.5 and 1m depth.  
 → hydraulic redistribution?