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Critical Evaluation of Soil Pore Water Extraction Methods on a Natural Soil

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Soil pore water extraction is an important component in ecohydrological studies for the measurement of δ^2H and δ^{18}O. The effect of pore water extraction technique on resultant isotopic signature is poorly understood. Here we present results of an intercomparison of commonly applied lab-based soil water extraction techniques on a natural soil: high pressure mechanical squeezing, centrifugation, direct vapor equilibration, microwave extraction, and two types of cryogenic extraction systems. We applied these extraction methods to a natural summer-dry (gravimetric water contents ranging from 8% to 15%) glacio-lacustrine, moderately fine textured clayey soil; excavated in 10 cm sampling increments to a depth of 1 meter. Isotope results were analyzed via OA-ICOS and compared for each extraction technique that produced liquid water. From our previous intercomparison study among the same extraction techniques but with standard soils, we discovered that extraction methods are not comparable. We therefore tested the null hypothesis that all extraction techniques would be able to replicate the natural evaporation front in a comparable manner occurring in a summer-dry soil. Our results showed that the extraction technique utilized had a significant effect on the soil water isotopic composition. High pressure mechanical squeezing and vapor equilibration techniques produced similar results with similarly sloped evaporation lines. Due to the nature of soil properties and dryness, centrifugation was unsuccessful in obtaining pore water for isotopic analysis. Cryogenic extraction on both tested techniques produced similar results to each other on a similar sloping evaporation line, but dissimilar with depth.