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Stable isotopes of soil water are affected by clay minerals: A post correction approach for dry soils based on physicochemical soil properties

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The cryogenic vacuum extraction is commonly used to access soil water that will be subsequently analyzed for stable isotopes (^{18}O and ^{2}H). However, the analytical error associated with this method is high compared to that of stable isotopes measured directly from water samples. Additionally, the accuracy of data derived from soil water extractions decreases with the increasing presence of fine compounds such as silt and clay. To overcome these limitations an extended applicability of the cryogenic vacuum extraction method is demonstrated. This study proposes two new methods to improve isotope values using the cryogenic vacuum extraction method. First, by showing that the extraction temperature of 205 ˚C improves the precision and the accuracy for all tested soil types. Secondly, that the post correction of data based on physicochemical soil properties and common extraction temperature will reduce errors.

Results show a reduction in error of d-values of soil water derived from soils with clay content between 0.1 to 48 %. The analytical error could be significantly reduced compared to previous studies by increasing the extraction temperature even for soils with high clay content. Soil water extractions from sandy soils are improved by halving the analytical error. If soil material is available, the proposed correction scheme can be applied to past isotope data and will improve comparability between studies and heterogeneous soils. It is recommended to conduct spike experiments prior to unsaturated zone isotope studies. We encourage future experiments with extraction temperatures above 205 ˚C. If previously oven dried substrate is used for standard preparation old water might remain in soil with a fine texture (i.e., high clay content) after oven drying at 105 ˚C and that this old water will enrich any added calibration water resulting in the enrichment of all samples normalized using it.