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Interactive comment

Interactive comment on "X Water Worlds and how to investigate them: A review and future perspective on *in situ* measurements of water stable isotopes in soils and plants" *by* Matthias Beyer and Maren Dubbert

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This is a very nice review of the current state of the art for in situ soil and plant water stable isotope analysis techniques, and I applaud the authors for this timely contribution. The focus of the review is on laser-based techniques, and this is the route that most researchers currently take. However, the use of soil gas measurements taken via soil gas wells or probes, specifically CO2, as a way to measure soil water oxygen stable isotopic composition, has not been included.

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Discussion paper

The basic principle is that in soils, the molar abundance of oxygen in soil water is orders of magnitude greater than the molar abundance of oxygen in coexisting soil CO2, so that the CO2 comes into oxygen isotope equilibrium with that of the soil water. Aliquots of soil gas are sampled via small diameter wells and stored in septum-capped vials for transport back to the lab. In the lab, the δ18O of the CO2 is measured via continuous flow or dual inlet IRMS.

I suggest the inclusion of this technique in the review manuscript because it enables researchers without access to laser instruments, but with access to conventional IRMS instruments to be able to make in situ soil water O isotope measurements. Below, I include some notes on potential references that the authors may wish to include in their review.

Stern and colleagues laid the foundation for the O isotope relationship between soil CO2 and soil water:

Stern, L., Baisden, W. T., & Amundson, R. (1999). Processes controlling the oxygen isotope ratio of soil CO2: Analytic and numerical modeling. Geochimica et Cosmochimica Acta, 63(6), 799-814.

Breecker and Sharp developed a technique for the sampling of in situ soil CO2 and its isotopic analysis: Breecker, D., & Sharp, Z. D. (2008). A field and laboratory method for monitoring the concentration and isotopic composition of soil CO2. Rapid Communications in Mass Spectrometry, 22(4), 449-454.

Breecker and colleagues deployed their in situ soil CO2 system and successfully measured soil water isotope profiles at high depth resolution ($\sim$10cm depth increments) at monthly intervals for more than a year at several sites:

Breecker, D. O., Sharp, Z. D., & McFadden, L. D. (2009). Seasonal bias in the formation and stable isotopic composition of pedogenic carbonate in modern soils from central New Mexico, USA. Geological Society of America Bulletin, 121(3-4), 630-640.

Oerter and Amundson measured soil water O isotope composition via soil CO2 at four sites for over a year. They were able to develop estimates of the depth of plant water uptake via comparison with xylem water samples, thus establishing the ecohydrologic applications of the soil CO2-water technique:

Oerter, E. J., & Amundson, R. (2016). Climate controls on spatial and temporal variations in the formation of pedogenic carbonate in the western Great Basin of North America. GSA Bulletin, 128(7-8), 1095-1104.

An added value of the use of soil CO2 sampling to measure soil water O isotope composition, is that the soil gas samples can also be measured for CO2, CH4, NOx, as well as other trace gases abundance. The ecohydrologic benefits and implications of these types of measurements were demonstrated in a later paper by Oerter and colleagues from the same field sites as the 2016 paper above:

Oerter, E., Mills, J. V., Maurer, G. E., Lammers, L. N., & Amundson, R. (2018). Greenhouse Gas Production and Transport in Desert Soils of the Southwestern United States. Global Biogeochemical Cycles, 32(11), 1703-1717.

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