Realtime in-situ determination of $^{18}\text{O}$ and $^2\text{H}$ in liquid water

Barbara Herbstritt (1), Benjamin Gralher (2), Markus Weiler (1)

Introduction
- Isotope studies are still a trade-off between limited spatio-temporal resolution and extensive lab work
- In conventional isotope analytics a significant time lag exists between sampling and data acquisition (unlike EC or T measurements)
- Laser-based analyzers are now available and capable of measuring stable water isotopes in the vapor phase directly and continuously
  > Challenge: Convert liquid water to water vapor and continuously provide it to analyzer

Experimental design

Membrane module specifications:
- Hydrophobic, PP-based hollow fibres
- Max. working temperature: 30 °C
- Total interfacial area: 100 cm²
- Liquid flow rate: 5 - 30 ml/min
- Max. gas pressure: 3.1 bar (25°C)
- External dimensions: 1x1x 0.5 inches

Pre-application
- Pure N₂, dry air
- Pre-application known water

Application: soil column experiment

Testing the method under highly unstable conditions (isotopically, thermally)
Verification by conventional analysis

Soil column parameters:
- Length: 50 cm
- Diameter: 10 cm
- Filling: fine sand
- Water flow rate: 27 ml/min
- Gas [N₂]: 195 ml/min

Possible further applications

Suitable wherever dynamic processes have to be observed in real time and with high temporal resolution

Conclusion
- Hydrophobic membranes may have specific isotopic fractionation factors
- The proposed method provides real-time data and captures even abrupt changes

Reponse time: about 10s (depending on setup dimensions and flow rates)
Resolution: minutes or below
Precision: comparable to conventional analysis (0.16% for $^{18}\text{O}$, 1.1% for $^2\text{H}$)
Supervision: minimum requirements
Restrictions: water temperature must not exceed ambient temperature (else: heating / dilution)