Water oxygen isotope systematics from source to stalagmites

A. BAKER[1,2]*, R. I. ACWORTH[1,2], M. S. ANDERSEN[1,2], M. O. CUTHBERT[1,3], P. W. GRAHAM[1], C. N. JEX[1,2], G. MARIETHOZ[1,2], C. E. MARJO[4], M. MARKOWSKA[1,2,5], G. RAU[1,2], H. ROSHAN[1,2], H. RUTLIDGE[1,2,4] AND P. C. TREBLE[5]

[1]Connected Waters Initiative Research Centre, UNSW Australia, Sydney, NSW 2052, Australia
*correspondance: a.baker@unsw.edu.au
[2]Affiliated to the National Centre for Groundwater Research and Training, Australia
[3]School of Geography, Earth and Environmental Sciences, University of Birmingham, Edbaston, B15 2TT, UK
[4]Mark Wainwright Analytical Centre, UNSW Australia, Sydney, NSW 2052, Australia
[5]Australian Nuclear Science and Technology Organisation, Lucas Heights, NSW2234, Australia

Stalagmite oxygen isotopic composition is a result of the numerous potential isotopic fractionation processes between the surface to the stalagmite. Some processes have been the focus of significant research, such as the thin-film hydrogeochmistry of dripwater on a stalagmite cap [1]. In contrast, processes affecting infiltration water oxygen isotopic composition from soil to cave have received little attention.

Here, we report on the first four years of experiments undertaken in a semi-arid environment. In 2010, we deployed the largest network of automated drip water loggers to understand infiltration water discharge characteristics [2]. From 2011 to 2013, we used this network to undertake drip water sampling, and used this data to constrain a model of the systematics of drip water oxygen isotope composition. From late 2013 we have commenced a series of artificial irrigation experiments, to understand oxygen isotope systematics at the scale of individual rainfall events.

Our experiments and models demonstrate that at our semi-arid site, water oxygen isotopic composition is likely to be fractionated at all stages of its movement from soil to cave, with water exfiltrating into the cave not reflecting the isotopic composition of surface precipitation. Moreover, our modelling approach identifies and quantifies the extent of oxygen isotope fractionation along the flow pathway, and permits the calibration of stalagmite oxygen isotope records from semi-arid regions.

[1] Deininger *et al* (2012) *Geochim. Cosmochim. Acta*, **96**, 57-79 [2] Jex *et al* (2012) *Int. J. Speleo.*, **41**, 285-298