

## Publication

The multifaceted relationship between leaf water  $^{18}\text{O}$  enrichment and transpiration rate**JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)****ID** 2226759**Author(s)** Cernusak, Lucas; Kahmen, Ansgar**Author(s) at UniBasel** [Kahmen, Ansgar](#) ;**Year** 2013**Title** The multifaceted relationship between leaf water  $^{18}\text{O}$  enrichment and transpiration rate**Journal** Plant, Cell and Environment**Volume** 36**Number** 7**Pages / Article-Number** 1239-1241**Keywords** Transpiration rate relates to within- and across-species variations in effective path length in a leaf water model of oxygen isotope enrichment

Leaf water becomes enriched in the heavy isotope  $^{18}\text{O}$  through the process of transpiration. The leaf water  $^{18}\text{O}$  signal is recorded in plant organic material (Barbour 2007), in atmospheric  $\text{CO}_2$  via the activity of carbonic anhydrase (Farquhar et. 1993), and in atmospheric  $\text{O}_2$  through photosynthetic  $\text{O}_2$  evolution (Guy, Fogel & Berry 1993). These signals can be harnessed for a range of applications in global change research and plant science, including reconstruction of climate, estimation of primary productivity, and analysis of environmental and genetic effects on stomatal conductance. Mechanistic models of leaf water  $^{18}\text{O}$  enrichment are required for these applications. A model to predict the  $^{18}\text{O}$  enrichment of an evaporating water surface was initially developed by Craig & Gordon (1965) and refined for application to leaves by Dongmann et. (1974). Building upon this, Farquhar & Lloyd (1993) proposed a model to relate the average, or bulk, leaf water  $^{18}\text{O}$  enrichment ( $\Delta^{18}\text{O}_L$ ) to that at the evaporative sites in the leaf ( $\Delta^{18}\text{O}_e$ ), whereby the diffusion of  $^{18}\text{O}$  enriched water away from the evaporative sites is opposed by the convection of unenriched vein water towards the evaporative sites (Fig. 1). They referred to this as a Péclet effect. As a result of the Péclet effect, the  $\Delta^{18}\text{O}_L$  is predicted to decrease as stomata open and transpiration increases for a given set of environmental conditions. This means that for plants growing alongside one another, the  $^{18}\text{O}$  enrichment of organic material can potentially provide an integrated measure of variability in stomatal conductance, which would be especially useful in ecophysiology and plant breeding

**Publisher** Wiley**ISSN/ISBN** 0140-7791 ; 1365-3040**edoc-URL** <http://edoc.unibas.ch/49556/>**Full Text on edoc** No;**Digital Object Identifier DOI** 10.1111/pce.12081**ISI-Number** WOS:000319875100001**Document type (ISI)** Article