

# High resolution SIMS $\delta^{18}\text{O}$ analyses of Hulu Cave speleothem at the time of Heinrich event 1

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## SIMS versus conventional analyses of speleothem $\delta^{18}\text{O}$

SIMS O isotope analyses of speleothems are capable of achieving much higher spatial and hence temporal resolution, however, owing to the difficulties of standardizing SIMS analyses, they are best adopted for investigating small windows of data containing relatively large  $\delta^{18}\text{O}$  variations [1]. Techniques used to minimise analytical uncertainties such as instrumental drift and geometric effects will be discussed.

## The abrupt 16.07 ka +2‰ shift at Hulu Cave

The strength of the SIMS method for measuring O isotopes in speleothems are highlighted by applying this technique to a 500-year interval of the well-known Hulu Cave record [2]. This interval includes a large abrupt +2‰ shift in  $\delta^{18}\text{O}$  at 16.07 ka, which may correlate to Heinrich Event I (H1). The high-resolution SIMS method provides annual to near-annual  $\delta^{18}\text{O}$  data, thereby increasing the temporal resolution of the previously published Hulu Cave data by approximately tenfold. SIMS  $\delta^{18}\text{O}$  data reveal that 75% of the abrupt isotopic shift at 16.07 ka occurred in just 1 to 2 years and the full +2‰ occurs over 6 years, compared with an upper limit of 20 years as previously determined by conventional methods employing micro-cutting, acid-digestion and  $\text{CO}_2$ -gas source mass spectrometry methods [2]. SIMS  $\delta^{18}\text{O}$  data also reveal numerous high amplitude (1-3‰), high frequency (<20 year) fluctuations not resolvable with microshaved data that are recorded in the several hundred years prior to 16.07 ka and may persist after the 16.07 ka event. The key difference between the rapid +2‰ shift at 16.07 ka and these other isotopic fluctuations is that the former represents a shift in speleothem  $\delta^{18}\text{O}$  that persists for hundreds of years whilst the latter are too short-lived to alter the broad speleothem  $\delta^{18}\text{O}$  trend.

## References

- [1] Y. Kolodny et al. (2003) *Chem. Geol.* **197**, 21-28.
- [2] Y.J. Wang et al. (2001) *Science* **294**, 2345-2348.