

Calibration of the 'clumped isotope' thermometer on natural travertine carbonates in the 5-95 °C temperature range

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The formation temperature of carbonates can be estimated by the newly developed clumped isotope ($\Delta 47$) method [1], however, there is still a large uncertainty in the published $\Delta 47$ -based calibrations. In this work recent calcitic and aragonitic travertines forming from natural springs and wells (5-95°C) from Hungary, Turkey, Italy and China were studied for stable- and 'clumped' isotopes, using both the newly developed technique of Schmid and Bernasconi [2] and the procedures of Huntington *et al.* [3] and Dennis *et al.* [4].

$\Delta 47$ data show an excellent correlation with T ($r^2 > 0.9$), indicating precipitation under equilibrium conditions in the vents. However, $\Delta 47$ values decrease away from the springs, which may be related to kinetic isotope fractionation due to CO₂ degassing. This empirical calibration based on vent samples significantly extends the calibration range of the clumped isotope thermometer. It can furthermore be used to derive the isotopic composition of the depositing waters from ancient deposits to reconstruct meteoric water compositions.

[1] Ghosh, P. *et al* (2006) *Geochim. Cosmochim. Acta* **70**, 1439-1456. [2] Schmid, T.W., Bernasconi, S. M. *Rapid Commun. Mass Spec.*, **24**, pp. 1955-1963, 2010 [3] Huntington, K. W. *et al J. Mass. Spectrom.* **44**, 1318-1329, 2009 [4] Dennis, K. J. *et al Geochim. Cosmochim. Acta* **75**, 7117-7131. 2011