

Oxygen isotope fractionation in travertine-depositing pools at Baishuitai, Yunnan, SW China: Effects of deposition rates

With the support by the National Natural Science Foundation of China, Prof. Liu Zaihua's group at the Institute of Geochemistry, Chinese Academy of Sciences, reported the effect of precipitation rates on oxygen isotopic compositions of travertine and thus their paleoclimatic implications, which was published in *Geochimica et Cosmochimica Acta* (2014, 133: 340—350).

Travertine $\delta^{18}\text{O}$ values can be used to reconstruct paleo-temperatures if the oxygen isotope fractionation factors between travertine and water are accurately understood. For this purpose, the $\delta^{18}\text{O}$ values of pool travertine and its parent water, and the deposition rates of the calcite were investigated at Baishuitai (Yunnan, SW China) over the course of the full hydrological year, April 23 2006—April 25 2007. The results show that the travertine-water isotope fractionation factors are close to the commonly accepted equilibrium line of Kim and O'Neil (1997, GCA). This differs from the results obtained by Yan et al. (2012, GCA) who found that the oxygen isotope fractionation factors in the travertine-depositing pools were close to the line suggested as equilibrium relationship by Coplen (2007, GCA). The average calcite deposition rate ($2.30 \text{ mg cm}^{-2} \text{ d}^{-1}$) in the present study is six times larger than that ($0.38 \text{ mg cm}^{-2} \text{ d}^{-1}$) by Yan et al. (2012, GCA). If slower calcite precipitation leads to equilibrium oxygen isotopic fractionation, then the results of this study support the results of Coplen (2007, GCA) that indicate that the equilibrium fractionation factor may be greater than the commonly accepted one derived by Kim and O'Neil (1997, GCA). The relationship between oxygen isotope fractionation factor and calcite deposition rate in this study also agrees with the results of Dietzel et al. (2009, CG) who found that the kinetic-isotope effect favors preferential incorporation of ^{16}O in solid calcite as the calcite deposition rate increases. There was a threshold for calcite precipitation rate control on oxygen isotopic equilibrium. In the case of travertine-depositing pools, when the calcite deposition rate was lower than $0.38 \text{ mg cm}^{-2} \text{ d}^{-1}$, oxygen isotopic equilibrium between calcite and water was attained. Therefore, calcite deposition rate is a potentially important consideration when using $\delta^{18}\text{O}$ in natural carbonates as a proxy for terrestrial and ocean temperature.

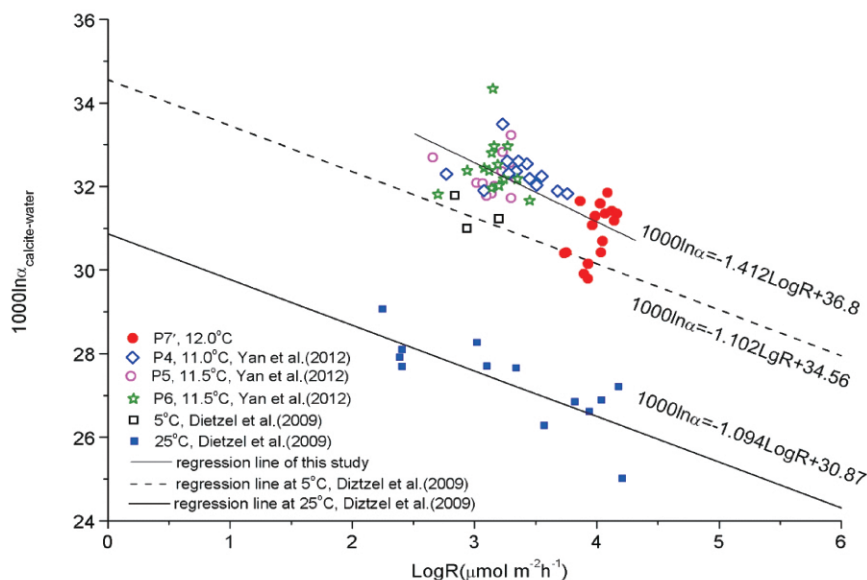


Figure Fractionation of oxygen isotopes between calcite and water vs. the calcite deposition rate at site P7'. Data of Dietzel et al. (2009) and at P4, P5 and P6 (Baishuitai, China) of Yan et al. (2012) were drawn for comparison.