

Blind speleothem calibrations: a cautionary tale from Crystal Cave

JUN HU¹ AND JULIEN EMILE-GEAY^{1*}

¹Department of Earth Sciences, University of Southern California, CA 90089, USA
(*correspondence: julieneg@usc.edu)

The oxygen isotope composition of speleothem calcite is commonly used as a paleoclimate proxy due to its potential for accurate dating and high resolution, but its interpretation can be complex. Here we present a cautionary tale from Crystal Cave, CA, which exemplifies the danger of statistical calibrations as the sole basis for proxy interpretation.

The Crystal Cave $\delta^{18}\text{O}$ record [1] was interpreted as a proxy for sea surface temperature in the Kuroshio Extension region on the basis of an apparently high correlation. Here we show that this result is an artifact of neglecting both the loss of degrees of freedom due to smoothing and the effect of age uncertainties.

First we revisit the correlation analysis by considering the effect of smoothing and the spectral properties of the $\delta^{18}\text{O}$ record and sea surface temperature field. The resulting degrees of freedom decrease by 1-2 orders of magnitude, making most field correlations insignificant. Consideration of the false discovery rate due to the “multiple hypothesis test” problem [2] further reduces this significance. Finally, we quantify age uncertainties using the Bchron age model [3], providing an ensemble of 1,000 possible realizations of the $\delta^{18}\text{O}$ time series. A statistical analysis of correlations with this ensemble challenges the published interpretation of the Crystal Cave record [1], finding no robust relationship to sea-surface temperature.

Our study cautions against “correlation-fishing” as a basis for paleoclimate interpretation, and reaffirms the importance of mechanistic studies as a foundation of this interpretation.

[1] McCabe-Glynn et al., (2013) *Nature Geosci.* **6**(8), 617-621.

[2] Benjamini & Hochberg (1995) *J. R. Stat. Soc. Ser. B (Methodological)*. **57**(1), 289–300.

[3] Haslett & Parnell (2008) *J. R. Stat. Soc. Ser. C- (Appl. Stat.)*. **57**, 399-418.