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Precise recalibration of clumped isotope thermometry applied to foraminifera

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Accurate reconstruction of past ocean temperatures is of critical importance to paleoclimatology. Marine paleotemperatures can be constrained using different proxies, many of which require independent assumptions (e.g., regarding biological processes or seawater composition) and/or region-specific calibrations. Carbonate clumped isotope thermometry ("$\Delta 47$") is a relatively recent technique based on the strong relationship between calcification temperature and the statistical excess of 13C-18O bonds in carbonates, and its application to foraminifera holds great scientific potential. Although paleotemperature reconstructions using this technique require no independent knowledge regarding the 18O composition of seawater, there are still relatively little published observations regarding the potential influence of other parameters such as salinity, pH, foramninifer size and species.
To address these issues, we present a new calibration data set based on a large number of analyses on 9 planktonic and 2 benthic species of foraminifera obtained from well-dated, recent sediments (core tops), with temperature coverage of -2°C to 26°C. We observe a very robust relationship between $\Delta 47$ values and independent temperatures estimates with a formal regression precision on the order of $\pm$ 1°C (95% CL). This data set confirms the absence of species-specific biases and salinity effects (Tripati et al., 2010; Grauel et al., 2013). We also investigated potential foraminifer size effects between 200 and > 560 μm in 6 species, and conclude that all size fractions from a given site and species display statistically undistinguishable $\Delta 47$ values. Because of the standardisation and precision, this calibration should provide a strong foundation for future studies of foraminiferal paleotemperatures.