Carbonate Clumped Isotope Thermometry of Bulk Planktonic Foraminifera

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Carbonate-clumped isotope thermometry (Δ_{47}) is an appealing tool to reconstruct ancient sea surface temperatures due to its thermodynamic basis and independence from changes in the $\delta^{18}O$ of seawater. Previous work to calibrate Δ_{47} for high resolution studies of past SSTs has focused on coccoliths and planktonic foraminifera [1,2]. One limitation of Δ_{47} for this application is the relatively large amount of material required for analysis compared to traditional $\delta^{18}O$ techniques. Advancements have been made in measuring Δ_{47} at small volumes using a Kiel device [3], however application of this technique on modern foraminifera still requires a large amount of sample to achieve the desired precision [2]. This has limited the application of Δ_{47} thermometry in high-resolution paleoceanographic studies, due to the difficulty of picking enough individuals of a single-species for analysis.

This study aims to reduce these complications by analyzing bulk planktonic foraminifera. We use modern, core top, samples to test if separating and analyzing individual species is necessary. Core top samples with glassy preservation (at size fraction of 63-250 microns) from locations ranging in temperature of 10-25°C were analyzed. Photographs of bulk samples were used to document species composition and therefore infer primary depth habitat of calcification. The temperatures derived from Δ_{47} of bulk planktonic foraminifera is consistent with the calibration of Zaarur et al. [4] when using calcification temperatures of relevant depth habitats (from the World Ocean Atlas). Preliminary application of the technique to planktonic foraminifera from the middle Eocene are also in agreement with previous SSTs from other proxy records. These results and recent work on bulk coccolith-rich sediments [5] are promising for simplifying high resolution Δ_{47} studies.

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