Cretaceous Tropical Sea Surface Temperatures from Bulk Foraminiferal Clumped Isotope Thermometery

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Carbonate-clumped isotope thermometry (Δ_{47}) is an important tool for reconstructing 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 sea-surface temperatures (SSTs) has focused on coccolithophores and species-specific planktonic foraminifera. As microscopic fossils, a limitation of applying Δ_{47} broadly in paleoceanography is the large amount of material required for analysis compared to traditional $\delta^{18}O$ techniques. This study aims to reduce this constraint by testing the suitability of mixed species bulk planktonic foraminifera for Δ_{47} thermometry. We consider two size fractions, the 63-125µm size fraction which includes small planktonic foraminifera and the 38-63µm, which is rich in smaller foraminifera and coccoliths. Assuming small planktonic foraminifera and coccolithophores live in the mixed layer, we correlate our bulk foraminiferal Δ_{47} to sea surface temperatures. We use material from thirteen core-tops to test the effect of size fraction on Δ_{47} values. Core-top material was sieved to the appropriate size fraction and slides representing each core-top location and size fraction were imaged to quantify the relative composition of microfossils, and other carbonate and non-carbonate material. Our results are consistent with other marine biogenic carbonates measured at Yale. They also have a similar slope as in previous species-specific foraminfeira calibrations, though the intercept is more positive. Preliminary application of the technique, using a marine biogenic Δ_{47} – temperature calibration on sediments from the Late Cretaceous, suggest that tropical SSTs reached ~ 42°C in the Turonian and cooled to ~25°C by the Maastrichtian, falling between previous estimates from $\delta^{18}O$ and Tex_{86}.