Phylogenetic Control of UK37-temperature Sensitivity: A Unifying Model for the Temperature Dependence of Alkenone Unsaturation

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Alkenone paleothermometry (via the and indices) has long been used to reconstruct sea surface temperature and has more recently been proven effective in lacustrine settings. Genetic analyses indicate that there is a diversity of different alkenone-producing lacustrine haptophytes, and differences among U^K_{37} -temperature calibrations suggest that unique calibrations might be required to quantify past temperature variation from individual lakes. The only term needed to quantify U^K_{37} -inferred temperature relative to a reference period (e.g., modern temperature, or 20th Century mean temperature) is the slope of the calibration regression, U^K_{37} -temperature sensitivity (i.e., the change in per °C temperature change). Here, we bring together all of the existing marine and lacustrine U^K_{37} -temperature calibrations in order to compare the variability among U^K_{37} -temperature sensitivities. We present evidence that U^K_{37} -temperature sensitivity is controlled by phylogeny and that even in the absence of a site-specific calibration, this term can be used to quantify past temperature variation from lake sediments if the genetic identity of the lake's alkenone-producer is known. Using the existing calibration data sets, we determine four phylotype-specific U^K_{37} -temperature sensitivities for use in cases where a site-specific calibration is unavailable. We also introduce a model that unifies all of the existing calibration data, provides new insight into the effect of temperature on alkenone unsaturation, and allows valuable quality control on down-core U^K_{37} -based temperature estimates.