Interrogating a paleothermometer: Understanding alkenone production by algae as a function of light and temperature

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Alkenones are lipids produced by haptophyte algae. They are used as a paleo thermometer because the relative amount of double bonds within the alkenone chains (U_{37}^{K}) depends on growth temperature. These 37 carbon chain lipids have ratios of double bonds relative to triple and tetra bonds that determine the U_{37}^{K}. Alkenones have been used to understand past temperature of ocean surfaces and are currently used to estimate past "terrestrial" temperatures using lake sediment cores. Many haptophyte species produce these alkenones but it is unclear in how each species varies in optimal growth rate, lipid production per cell, and temperature sensitivity (U_{37}^{K}) as it is affected by diverse light and temperature conditions. The goal of this study was to culture, measure growth rate, and quantify U_{37}^{K} of four haptophyte species at two light levels and four temperatures. Changes in U_{37}^{K} were driven by changes in cell specific concentrations of triple and double bonds of 37 carbon chains. Light affected growth rate, but had little effect on U_{37}^{K}. U_{37}^{K} for all species rose as a function of temperature, but the temperature sensitivity were consistent with phylogenetic position within the haptophytes. This work has implications for improved temperature calibration of past climate.