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Exploring systematic bias in $U^{K'}_{37}$ in the Mediterranean Sea through alkenone flux and coccolith clumped isotope measurements in a 28-year sediment trap record

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In Mediterranean Sea surface sediments, the alkenone-based $U^{K'}_{37}$ paleothermometer produces reconstructed temperatures often 4-5 °C below mean annual sea surface temperatures (SSTs) in the overlying waters. Paleoclimate studies interpret $U^{K'}_{37}$ SSTs as being a winter temperature, however, sediment trap studies suggest that coccolithophores mostly bloom in fall and spring. In addition, alkenone production below the mixed layer or in low-nutrient conditions could also lead to low proxy temperatures.

To identify the source(s) of this proxy bias and thereby improve the reliability of $U^{K'}_{37}$ temperatures in the Mediterranean Sea, we here analyze alkenones in sediment traps set in the ultraoligotrophic Ionian Sea between 1991 and 2018, with traps set at multiple depths (about 500, 1500, and 2500 m) between 1999 and 2011. Comparison of the highest and lowest $U^{K'}_{37}$ values with satellite-based SSTs indicates a delay of about 45 days for material to reach the upper trap. After adjusting for this, $U^{K'}_{37}$ values translate into temperatures generally 3-8 °C lower than satellite-based SSTs throughout the seasonal cycle. This suggests that low $U^{K'}_{37}$ SSTs in Mediterranean Sea sediments are not simply an effect of seasonal production and export, but that alkenone production below the mixed layer or the impact of limited nutrient availability may also contribute to proxy bias.

To explore this further, clumped isotope measurements will be performed on coccoliths isolated from selected samples. This data will provide evidence of the habitat temperature and depth of coccolithophores in the Eastern Mediterranean Sea, shedding further light on the source of bias on the $U^{K'}_{37}$ paleothermometer in this region.