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C_{40} ALKENONES AS A POTENTIAL SEA SURFACE TEMPERATURE PROXY FOR THE CRETACEOUS

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The primary focus in the application of alkenones as paleotemperature proxies has been on C_{37} compounds, which are usually the most abundant components observed in both algal cultures and in sediments. Instances of applications of other alkenone homologs, typically C_{38} components, are rare. Yet the utility of sedimentary C_{37} alkenone compositions as molecular SST proxies is constrained by two factors associated with triunsaturated alkenones. First, the progressive decrease in the proportion of the $C_{37:3}$ alkenone as temperature increases results in $U^{K'}_{37}$ values of unity above 28 °C, which precludes assessment of SSTs above this temperature limit. However, recent evidence suggests that application of $U^{K'}_{38}$ based on C_{38} alken-2-ones ($[C_{38:2Me}]$)/($[C_{38:2Me}$+ $C_{38:3Me}]$)), affords a temperature limit higher than that of $U^{K'}_{37}$. Second, the initial appearance of triunsaturated alkenones was thought, until recently, to be in the early Eocene, thereby restricting the temporal range of the alkenone SST proxy. Recognition of a C_{40} triunsaturated alken-3-one ($C_{40:3}$) in a Cenomanian-Turonian sediment sequence associated with OAE2 (Ocean Anoxic Event 2) from high southern latitudes in the Mentelle Basin has now revised this temporal limit. Moreover, calculation of the $U^{K'}_{40}$ index ($[C_{40:2Et}]$)/($[C_{40:2Et}$+ $C_{40:3Et}]$)) for this interval revealed temporal shifts that likely reflect variations in SST during OAE2.

Campanian to Paleocene (~76-60 Ma) sediments recovered from the Transkei Basin (Hole U1581B), offshore South Africa, during IODP Expedition 392 contain series of C_{37}-C_{40} alkenones, often expanding their temporal ranges. These data confirm disparities between alkenone distributions for this period and those in extant haptophytes. The Cretaceous interval from the Transkei Basin sedimentary succession contains $C_{40:2}$ and $C_{40:3}$ alken-3-ones (***Fig. 1***), with the former often the dominant or only alkenone detected. Their dual occurrence enabled calculation of the $U^{K'}_{40}$ index, which shows a cooling trend during the late Cretaceous (***Fig. 1***), consistent with evidence from TEX_{86} records. Thus, C_{40} alkenones may enable extension of alkenones as an SST proxy to the Cretaceous, especially if trends in their profiles can be further validated through direct comparison with TEX_{86} profiles.

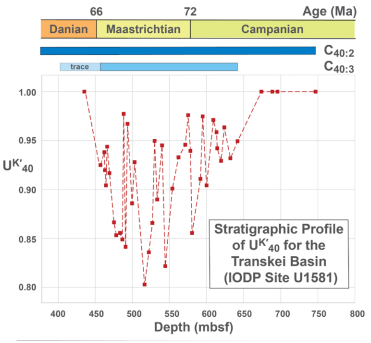

Fig. 1: Stratigraphic records of alkenones in the sediment sequence recovered from Site U1581 in the Transkei Basin during IODP Expedition 392. The temporal range of occurrences of $C_{40:2}$ and $C_{40:3}$ alken-3-ones are represented by horizonal blue bars. Their co-occurrence enables calculation of the $U^{K'}_{40}$ index ($[C_{40:2}]$)/($[C_{40:2}$+$C_{40:3}]$)) as an analog of the $U^{K'}_{37}$ SST proxy. The profile of $U^{K'}_{40}$ values for the Campanian and Maastrichtian is consistent with the established cooling trend well documented in temperature records based on TEX_{86} data from other locations.