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EVOLUTIONARY LINEAGES OF ALKENONES RECORDED IN CRETACEOUS AND PALEOCENE SEDIMENTS FROM THE TRANSKEI BASIN (IODP SITE U1581)

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C_{37}-C_{40} alkenones derived from haptophyte algae [1] were identified in Campanian to Paleocene (~76-60 Ma) sediments recovered from the Transkei Basin (Hole U1581B), offshore South Africa, during IODP Expedition 392 [2]. These occurrences extend the temporal continuity of alkenones and expand their paleogeographic range to southern high latitudes (~58°S) during this time interval [3-7], while their distributions exhibit several transitional features (***Fig. 1***). Cretaceous samples contain $C_{40:3}$ and $C_{40:2}$ alken-3-ones, confirming disparities between alkenone distributions for this period [4-7] and extant haptophytes. C_{40} alkenones have only once been reported in marine species from phylogenic Group III [8] but are common constituents of species in phylogenic Group II [9,10]. The high relative abundance of $C_{40:2}$ alken-3-one [4-6] and other aspects of alkenone compositions in pre-Eocene (>56 Ma) sediments appear typical of lacustrine rather than marine Quaternary settings [11]. Thus, Cretaceous through Paleocene marine sediments may reflect alkenone contributions from both Isochrysidaceae and Noelaerhabdaceae following their Early Cretaceous divergence [12], recording a broader suite of alkenone biosynthetic pathways than marine haptophytes now express. The occurrence of C_{37} and C_{38} alkatrienones in Paleocene samples revises the timing of their first appearance and refutes the hypothesis [13] that this biosynthetic innovation in haptophytes reflects a post-EECO response to ocean cooling. Similarities in alkenone profiles for Maastrichtian and Danian samples suggests conformity in their biosynthetic pathways across the Cretaceous/Paleogene (~66 Ma) boundary, attesting to survival and subsequent recovery of their source haptophytes after the extinction event.

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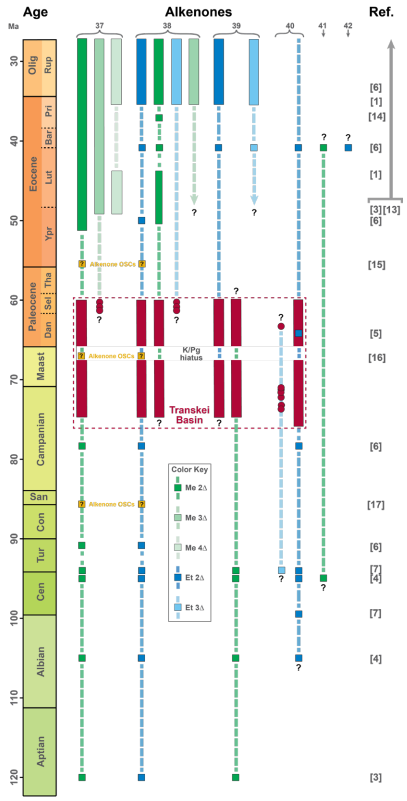

Figure 1: Compilation of the observed temporal ranges of specific C_{37} - C_{42} alkenones based on their reported distributions in marine sediments ranging from early Oligocene (28 Ma) to early Aptian (120 Ma). Individual solid lines reflect the occurrence of each alkenone [1,3-7,13, 14] in marine sediments, color-coded according to their alkylation (Me versus Et) and unsaturation (i.e., 2Δ, 3Δ or 4Δ), coupled with reports of C_{37} and C_{38} alkyl thiophenes (shown in gold labelled Alkenone OSCs [15-17]). Colored dashed lines represent the inferred interpolated ranges for the temporal continuity in the biosynthesis of specific alkenones. The question marks designate times where current data show punctuations in reports of alkenones that correspond with the first appearance of compounds linked to biosynthetic innovations or instances where they are last identified in the marine sediment record suggesting evolutionary changes in the production of specific alkenones by haptophytes or a shift in their preferred or dominant biosynthetic pathways. Samples from the Transkei Basin (in red) span a time interval that is represented by only one other study [5] but includes several key transitions in alkenone compositions marked by first and last appearances of individual components.