Evolutionary Developments in Alkenones from the Campanian to Paleocene Recorded in Sediments from the Transkei Basin (IODP Site U1581)

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Campanian to Paleocene organic-rich sediments (~74-60 Ma) recovered from the Transkei Basin (Hole U1581B), offshore South Africa, during IODP Expedition 392 contain suites of C37-C40 alkenones derived from haptophyte algae that extend the temporal continuity of their occurrences and expand their paleogeographic range to high southern latitudes (~58°S) during this time interval. Alkenone profiles are broadly similar throughout the stratigraphic section with the similarity between Maastrichtian and Danian samples indicating a conformity in biosynthetic pathways across the K/Pg boundary. Thus, the source haptophytes for alkenones survived and subsequently recovered after the extinction event, consistent with temporal trends for assemblages of calcareous nannoplankton from the southern hemisphere. The lineages of specific alkenones record evolutionary developments in their biosynthetic pathways. The occurrence of a methyl C39:2 alkenone in the Paleocene and both methyl and ethyl C38 and C39 alkenones in the Campanian extends the range of occurrence of alkenone with carbonyl groups at multiple positions, and the required duality in their biosynthetic pathways. The dominance of the C40 alkadien-3-one in several samples contrasts with its scarcity in Neogene marine sediments and presence among extant haptophytes. C40 alkenones are prevalent constituents of coastal and lacustrine species in phylogenic Group II, notably *Isochrysis*, but have only once been reported in marine species from phylogenic Group III. The sporadic prominence of C40 alkenones prior to the early Eocene seems to reflect a broader suite of active biosynthetic pathways than those expressed by extant marine haptophytes. Thus, Cretaceous through Paleocene marine sediments may reflect alkenone contributions from both Isochrysidaceae (Group II) and Noelaerhabdaceae (Group III) following their divergence in the Early Cretaceous. The accompanying C40:3 alkenone contrasts with the absence of other alkatrienones prior to the appearance of C37 and C38 components in the Paleocene. These data refute the hypothesis that alkatrienones represent a response in haptophyte producers to ocean cooling after the early Eocene Climatic Optimum (EECO) and suggest this biosynthetic innovation may have originated at high southern latitudes.