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Late Cretaceous cooling trend and planktonic foraminiferal turnover: a new species-specific δ18O record from the southern mid latitudes.

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The Late Cretaceous was characterized by extreme greenhouse conditions with maximum warmth likely reached in the Turonian. This warmth was followed by a prolonged cooling trend lasting up to the mid Campanian. The late Campanian–Maastrichtian had relatively variable conditions and exhibited low amplitude cooling and warming intervals. The main Turonian–Campanian cooling phase was likely associated with changing intermediate and deep-water circulation including enhanced deep-water formation in southern high latitudes. Keeled Cretaceous planktonic foraminifera underwent a major turnover across a $\sim$5 m.y. long Santonian–early Campanian interval, but the main controlling factors and how they might relate to changing greenhouse climate dynamics have never been established. This lack of understanding is related to the limited recovery of stratigraphically complete Turonian–early Campanian sediments from DSDP, ODP and IODP cruises and to poor preservation of microfossils that compromises stable isotope approaches for reconstructing paleoceanographic conditions and species paleoecological preferences. Further uncertainty is introduced by several recent studies that found a traditional morphologically-based scheme for the interpretation of Cretaceous planktonic foraminiferal paleoecology likely incorrect. For instance, several keeled species always interpreted as deep-dwellers yield an isotopic signature that suggests a near-to-surface habitat, whereas several small biserial, planispiral and low trochospiral taxa may have inhabited deep layers of the water column.

Our study based on planktonic foraminiferal species-specific δ18O values from Exmouth Plateau (ODP Leg 122, Hole 762C; western Indian Ocean) provides a continuous and highly resolved record of the Turonian–Campanian climatic evolution of the southern mid latitudes that documents persisting warmth up to the mid Santonian, provides new information on species paleoecological preferences and sheds new light on the interpretation of the faunal turnover occurring among planktonic foraminifera. In detail, Santonian double keeled species (genera Dicarinella and Marginotruncana) inhabited near-to-surface ecological niches, and the timing of their progressive extinction seems to parallel specific steps of the sea-surface cooling. Campanian species of the genera Contusotruncana, Globotruncana and Globotruncanita, initially diverged from their keeled shallow-dwelling ancestors to occupy a deeper/cooler habitat and then migrated upward in the water column, when the Santonian species disappeared. The main turnover occurring among Late Cretaceous planktonic foraminifera seems, therefore, directly related to the decreasing sea-surface temperatures and to a more successful adaptation of the surveying taxa to cooler waters.