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Long eccentricity cycles in the Cretaceous; implications for timescale development and relationship with sea level.

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Time series analysis of a very large composite data set of bulkgδ13C data representing approximately 30 myr of mid Cretaceous time (Aptian-Santonian) reveals the presence of long eccentricity cycles with frequencies of 400 kyr and 2.4 myr. These are used to develop a new orbital timescale for the Cretaceous. Time-time plots of radiometric dates against the orbital timescale show considerable agreement in the interval from the Mid Cenomanian to Late Santonian, and largely confirm the high precision of radiometric dates derived from Western Interior bentonites. However, the orbital timescale for the Aptian, Albian and Early Cenomanian differs markedly from the recently published Gradstein et al 2004 timescale, being more than 10 million years shorter. The source of this discrepancy is not clear; it could in part reflect major errors in biostratigraphical dating of ashes from the far north of the Western Interior Seaway, or incorrect assumptions of ocean spreading rates for this time interval. It is unlikely to be caused by hiatuses on the 2.4 myr scale. We have integrated the new timescale with high resolution primary data of ammonite distributions, which allows characterisation of numerous individual 400kyr cycles from biostratigraphical criteria. There is a close relationship between periods of rapid sea level change and eccentricity maxima on both the 400 kyr and 2.4 myr cycles. Major events, such as the Cenomanian-Turonian Boundary Event (oceanic anoxia) coincide with eccentricity maxima. Identification of long eccentricity cycles is particularly useful because it allows timescales to be developed rapidly and efficiently.