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The last 1.2 Myr of the Cretaceous in the southwestern Tethys (Elles, Tunisia): orbital calibration, climate change and calcareous nannofossil palaeoecological changes

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An integrated study of magnetic mass susceptibility (MS), bulk stable isotopes and nannofossil paleoecological changes has been performed on the late Maastrichtian of the Elles section, central Tunisia, spanning the last 1.2 Myr of the Cretaceous. A cyclostratigraphic analysis of MS variations reveal the presence of Milankovitch and sub-Milankovitch frequencies. Orbital tuning is used to provide ages of important stratigraphic events, relative to the age of the Cretaceous-Paleogene boundary (K-PgB). Principal Component Analysis (PCA) performed on the nannofossil assemblage reveal two main factors, PCA1 and PCA2, which match changes in bulk Delta13C and Delta18O, respectively, and allow building a nannofossil fertility (NFI) and a nannofossil temperature index (NTI). The NTI, the variations in abundances of high-latitude taxa and the warm-water species Micula murus, and variations in bulk and foraminifer Delta18O point to a common paleoclimatic interpretation. Sea-surface paleotemperatures were mild and variable between 67.2 and 66.5 Ma with an enhanced cooling event between 66.7 and 66.5 Ma. The end-Maastrichtian greenhouse warming is recorded between 66.5 and 66.15 Ma. Cooling resumed between 66.15 and 66.05 Ma while the last 50 kyr of the Maastrichtian are marked by an additional warming event. An overall decrease in surface-water nutriency is indicated by the NFI and suggests that the concomitant decrease in bulk Delta13C was mainly due to a drop in overall plankton productivity. The previously published species richness of intermediate-dwelling planktic foraminifera parallels the trends in the NFI, indicating a direct link between the drop in surface-water nutriency and stressful environmental conditions within the nutricline. Nannofossil species richness is slightly lower during warming episodes. This suggests stressful conditions accompanying greenhouse warming pulses. However, nannofossil species richness remained on average very high across the last 1.2 Myr of the Cretaceous, indicating a relatively weak impact of Cretaceous Deccan volcanism on the nannoplankton community in the Elles section before their mass exctinction at the K-PgB.