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Progress in Late Cretaceous planktonic foraminiferal stable isotope paleoecology and implications for paleoceanographic reconstructions

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Paleoecological preferences proposed for Cretaceous planktonic foraminiferal taxa have traditionally been based on morphological analogies with depth-stratified modern species, on biofacies comparison in continental margin and deepwater settings, and limited oxygen and carbon stable isotope data. These studies concluded that large-sized, keeled and heavily calcified planktonic foraminifera generally lived at deeper levels in the surface waters than small-sized, thinner-walled non-keeled species.
Stable isotope data have been used to infer information on paleotemperature, paleoceanography and paleoproductivity of ancient oceans and constrain biological paleo-activities (i.e. photosymbiosis and respiration) of fossil species. These studies have suggested that the depth-distribution model based on analogy with modern taxa might not be fully applicable for Cretaceous species, and found particularly ^{13}C-enriched values in some Maastrichtian multiserial taxa that have been related to the activity of photosymbionts.
We have collected about 1500 δ^{18}O and δ^{13}C species-specific analyses on glassy preserved planktonic foraminifera from Tanzania (Tanzania Drilling Project TDP sites 23, 28 and 32) and well-preserved planktonic foraminifera from other mid-low latitude localities (Shatsky Rise, northwestern Pacific Ocean, ODP Leg 198 Hole 1210B; Exmouth Plateau, eastern Indian Ocean, ODP Leg 122, Hole 762C; Eratosthenes Seamount, eastern Mediterranean, ODP Leg 160, Hole 967E; Blake Nose, central Atlantic Ocean, ODP Leg 171B, holes 1050C and 1052E) to investigate Late Cretaceous species paleoecological preferences, life strategies and depth distribution in the surface water column.
Our results indicates that several large-sized (> 500 μm) double-keeled species belonging to the genera *Dicarinella*, *Marginotruncana* and *Contusotruncana*, generally interpreted as deep to thermocline dwellers, instead occupied shallow/warm layers of the water column, whilst not all biserial species were adapted to shallow layers and eutrophic environments (Falzoni et al., 2013; Falzoni et al., in prep.). Interestingly, globigeriniform planktonic foraminifera with meridional ornamentation (*Paracostellagerina* and *Rugoglobigerina*), a morphological feature generally considered to be genetically controlled and thus taxonomically significant, typically yield higher δ^{13}C values than co-occurring finely ornamented morphotypes (Petrizzo et al., 2008). A possible explanation to these results invokes the presence of facultative photosymbionts enhancing test calcification or alternatively, the occurrence of ecophenotypes adapted to a different sea-surface ^{13}C/^{12}C ratio within the same fossil species (Falzoni et al., 2014).
Finally, we discuss evidences against the traditional species depth-distribution model and highlight the restrictions in performing Late Cretaceous paleoenvironmental and paleoceanographic reconstructions based on shell morphology and/or inferred life strategies of planktonic foraminifera.

References

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