The impact of the Pliensbachian-Toarcian crisis on belemnite diversity and size distribution

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The Pliensbachian–Toarcian transition has been considered a major bottleneck in the early evolution of belemnites, probably related to major palaeoenvironmental and climatic changes during the Early Toarcian. Previous research has focused on the study of belemnites from higher, temperate latitudes, while high-resolution studies on diversity and size of subtropical belemnite assemblages in the northwest Tethys are comparatively rare. The lack of high-resolution (ammonoid subzone) abundance data on diversity and size distributions of belemnite assemblages does not allow separating changes during the Pliensbachian–Toarcian boundary event from those during the Toarcian anoxic event. Sample standardized diversity analyses on new data from Iberian sections suggest the Pliensbachian–Toarcian corresponds to a slight decrease in diversity and an adult size decrease within dominant species. Cluster and non-metric multidimensional scaling analyses, however, indicate that the largest changes in diversity and palaeogeographic distribution of belemnite assemblages occurred during the Toarcian oceanic anoxic event (TOAE) rather than the Pliensbachian–Toarcian boundary. In southern basins like the Lusitanian Basin and Riff Mountains, belemnites even disappear entirely during the TOAE. More generally, the TOAE corresponds with an increase in body size of belemnite assemblages driven by species turnover. The lack of widespread anoxia in southern basins of the northwest Tethys indicates that direct impact of warming or increased pCO2 triggered by volcanism as well as indirect effects on nutrient availability and productivity might have played an important role during both crises.