THE ROLE OF ENVIRONMENT IN THE DIVERSITY AND EVOLUTIONARY TURNOVER RATES OF THE FORAMINIFERIDA

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Taxonomic databases are important tools in the study of faunal diversity and evolution. The usefulness of the inferences drawn from these databases is diminished when the role of environment is not considered. Analysis of the foraminiferal database at the genus and family levels is used to demonstrate the effect of water depth on presumed changes in taxonomic diversity and evolutionary turnover rates.

This paleoenvironmental effect is particularly noticeable when foraminiferal faunas of the late Paleozoic and the Mesozoic and Cenozoic intervals are compared. The late Paleozoic fauna is dominated by the Fusulinina and shallow-water (0-200 m) Textulariina. Standing diversity fluctuates greatly, and evolutionary turnover is high. This reflects short-term fluctuations in sea level which led to the rapid formation and destruction of narrow ecological niches. Evolutionary turnover appears to be related to reef growth during this time. This trend may also reflect an increased number of k-selected specialists which serve as proxy indicators for a slow-circulating oligotrophic ocean system. Shallow-water taxa may also be predisposed to extinction due to their reliance on symbiotic algae. The extinction event at the end of the Permian resulted in the loss of almost 70% of the standing generic diversity. This included the complete loss of the Fusulinina as well as a number of shallow-water textularids. Cohort survivorship curves are steep and taxon ages short during this time.

The diversity increase over the past 245 million years has largely been due to the addition of deep-water (200-10,000 m) taxa. This was particularly true during the Late Cretaceous and early Eocene, and may reflect the relatively high eustatic sea level during those intervals. The relationship between reef development and evolutionary turnover rates is less clear during this time interval. Although the extinction event that marked the end of the Cretaceous resulted in a greater loss in absolute taxonomic diversity than occurred at the end of the Permian, the relative loss in generic diversity was only about 21% due to the large number of deep-water taxa. When the entire fauna is considered, cohort survivorship curves are less steep and taxon ages are longer than in the late Paleozoic, but when only the shallow-water taxa are considered, the results are similar to those for the late Paleozoic.