

AN ANALYSIS OF THE RANGES OF GLOBIGERININA (FORAMINIFERIDA) GENERA AND THEIR BEARING ON THE CRETACEOUS-TERTIARY BOUNDARY

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ABSTRACT

An analysis of the Globigerinina genera from the Middle Jurassic to Holocene, using the method of Cutbill & Funnell, indicates that a major break of the Globigerinina genera occurred at the Maastrichtian-Paleocene boundary (loss) and at the Oligocene-Miocene boundary (gain). This break seems to be marked by an abnormally high rate of extinction of most genera followed by an accession of new ones at the Maastrichtian-Paleocene boundary and at the end of the Oligocene.

INTRODUCTION

The Globigerinina first appeared in the Middle Jurassic (Loeblich & Tappan 1984) and increased in number of species throughout the Mesozoic and Cenozoic. More than 88 genera and 1100 species have been recorded (Loeblich & Tappan 1964, 1988; Brasiers 1980; Kennett & Srinivasan 1983; Caron 1984; Tumarkine & Luterbacher 1984). Of these, 730 species have been reported from the Tertiary and about 70 species are still living today. The relative abundance of the known Globigerinina species is shown in figure 1.

One of the most striking features of the distribution of Globigerinina is their great abundance from the beginning of the Tertiary, in which the number of species, in the Paleocene, reaches twice that of the Maastrichtian. During the Eocene the number of species reaches three times the number of Maastrichtian species. In the Oligocene, however, the number decreases to reach almost the same number as that of Maastrichtian forms. During the Miocene, the number of planktonic foraminiferal species attains a new climax followed by a decrease in the Late Tertiary and Quaternary.

The cause of these changes in the rate of increase and decrease of Globigerinina species may be related to global changes in environmental conditions as

Analysis of the ranges of *Globigerinina* Genera

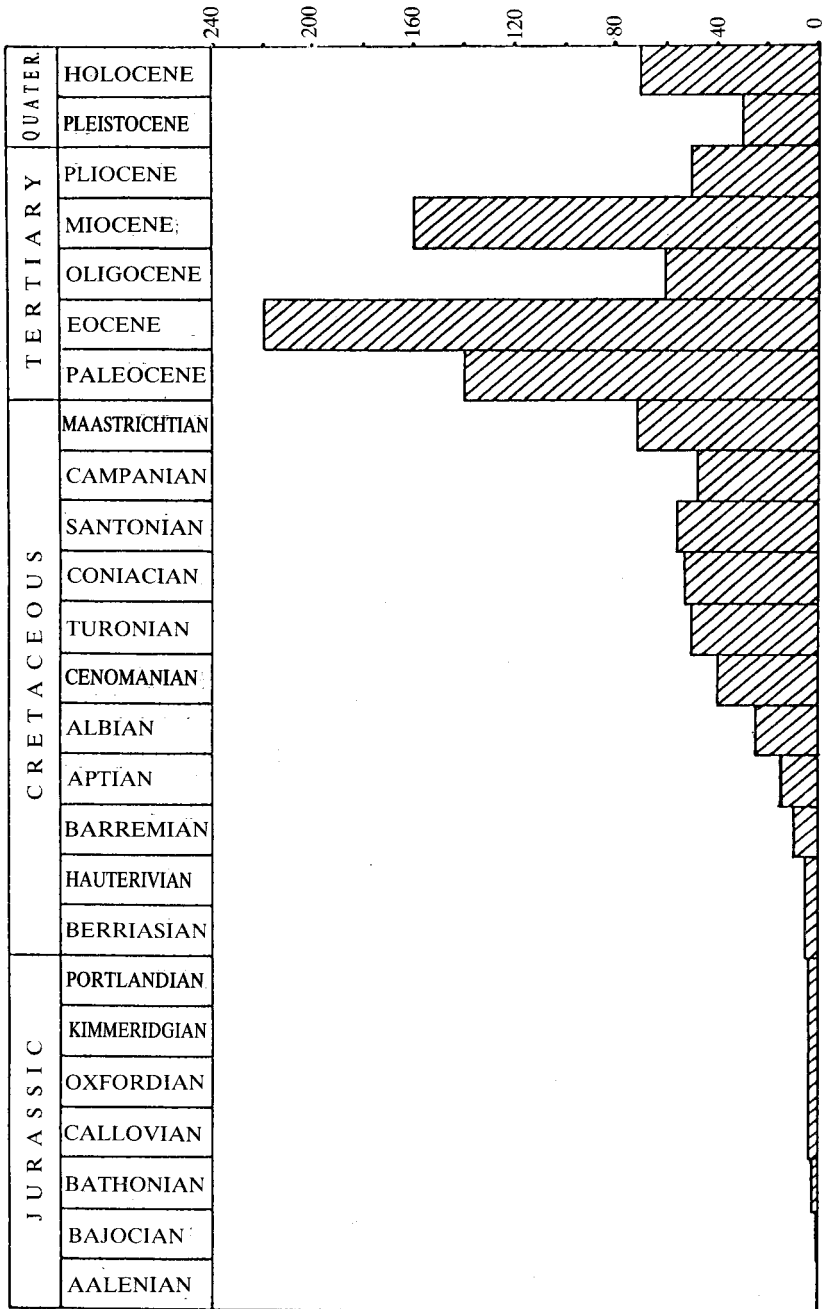


Fig. 1: Relative abundance of *Globigerinina* species in successive divisions of Middle Jurassic to Recent (Modified after Brasier, 1980).

temperature and salinity, which seem to have decreased at the beginning of Tertiary (Davies & Eames 1971). These conditions changed again during the Miocene.

METHODS

The analysis of variations in the temporal distribution of planktonic foraminiferal genera is carried out by using the method of Cutbill & Funnell 1967. The following measures were determined for the i^{th} stage:

F_i : The number of genera appearing for the first time in stage i .

L_i : The number of genera occurring for the last time in stage i .

P_i : The number of genera present in stage i .

$F_i - L_i$: The net loss or gain in stage i .

$$\frac{(F_i + L_{i-1})100}{P_{i-1} + F_i}$$

$P_{i-1} + F_i$: The relative change of genera across a boundary (= relative turn over) calculated from the number of genera "Firsts" in the stage / i plus the number of "Lasts" in the stage below) divided by (number of genera present in the stage below plus the number of "Firsts" in the stage i) multiplied by 100 to give percentage.

$F_i - L_{i-1}$: Net loss or gain across boundaries (= net profit and loss), calculated from (number of "Firsts" in the stage i minus the number of "Lasts" in the lower stage).

RESULTS

The results are presented in figures 2 and 3. It is clear from figure 2-a that from the Maastrichtian to the Eocene there was a steady but gentle increase in the number of first appearances and also during the Miocene. At the same time, there was an abrupt decrease in the number of genera disappearing (Lasts) from the Maastrichtian to the Paleocene and also from the Eocene to the Oligocene (fig. 2-b).

The number of genera present within each stage gradually increased from the Bajocian to the Maastrichtian, but generally it started to decrease from the Maastrichtian to the Holocene except in the Eocene and Miocene (fig. 2-c).

There is only minimal gain or loss within each stage (fig. 2-d) except in the Maastrichtian which is characterized by the loss of a large number of Globigerina

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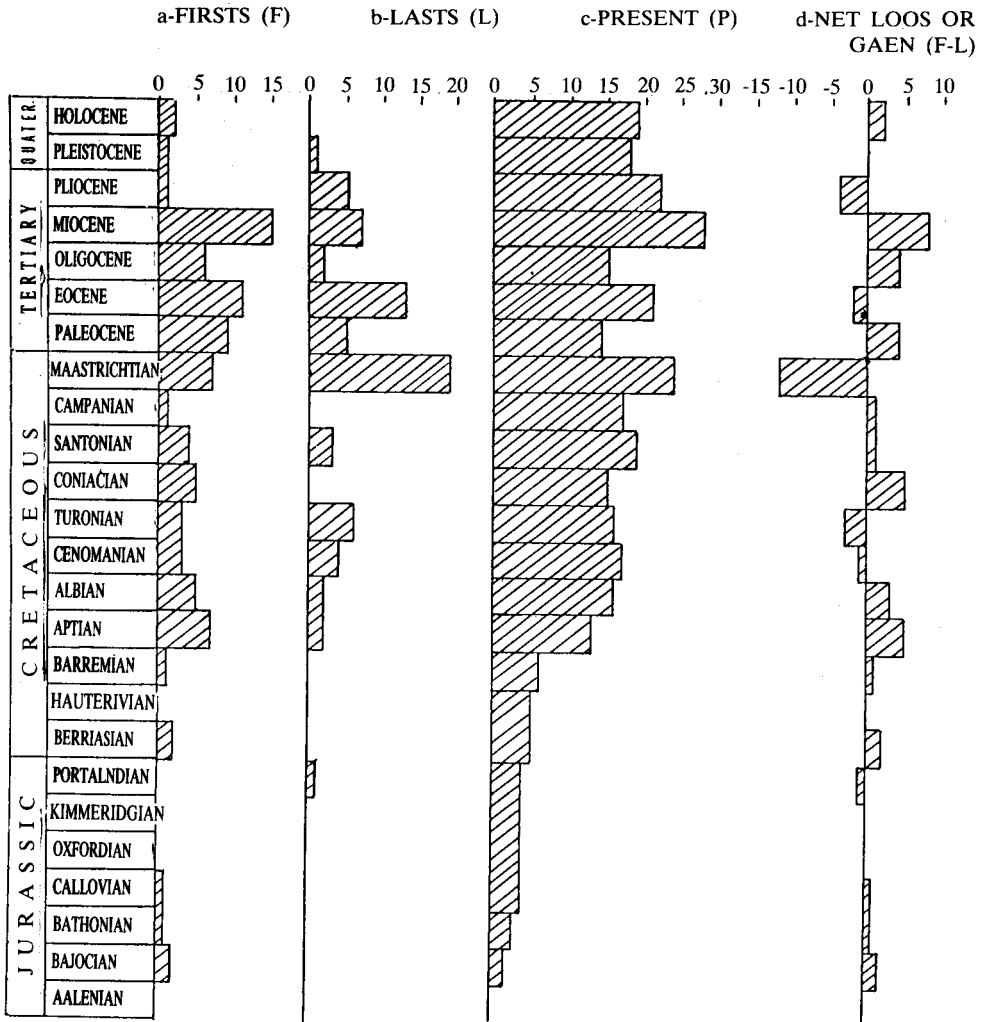


Fig. 2: a): "Firsts" (F) = The number of genera appearing for the first time in each stage.

b): "Lasts" (L) = The number of genera occurring for the last time in each stage.

c): Present (P) = The number of genera present in each stage.

d): Net loss or gain within each stage (F - L).

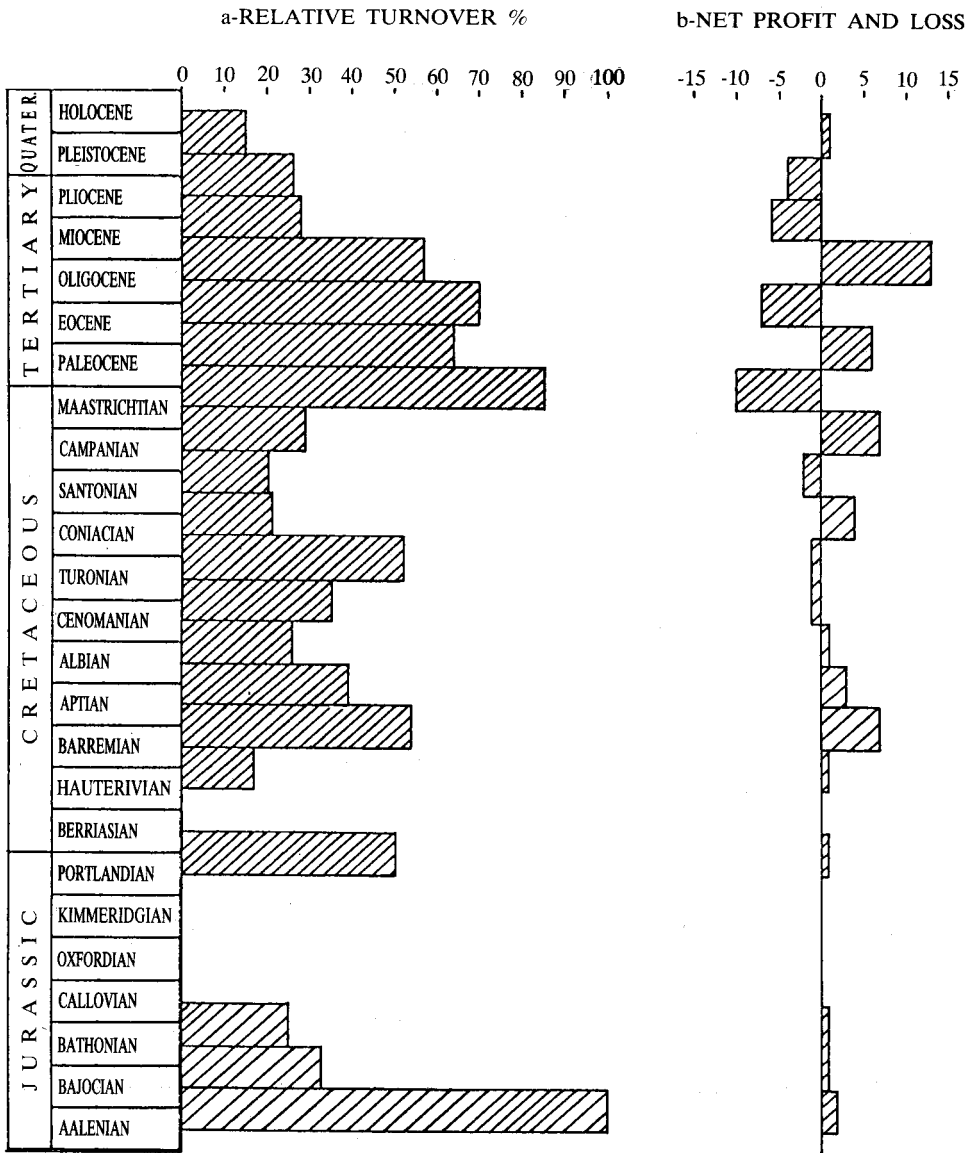


Fig. 3: a): Relative turnover across stage boundaries.

b): Net profit and loss across stage boundaries.

genera, and vice-versa, in the case of the Miocene, which is characterized by the gain of a large number of genera.

It is evident from all the histograms (figs. 2a-c) that there is a major change in the number of genera during Maastrichtian and Miocene times. The difference between the Paleocene and Maastrichtian faunas is clearly brought out in figure 3a-b, which shows a 85% relative turnover and an astounding net loss in genera across the boundary. This indicates a marked break.

The same break can be observed between the Oligocene and the Miocene with 70% relative turnover and an astounding net gain in genera.

From the above analysis of the Globigerinina genera, there is a major change in the number of genera across the boundary between the Maastrichtian and the Paleocene periods on one hand and between the Oligocene and Miocene on the other hand.

This study shows that the most important change in Globigerinina faunas occurred at the Maastrichtian-Paleocene boundary, which witnessed the biggest extinction of Globigerinina genera (17 genus) and in the Oligocene-Miocene boundary, where the biggest appearance of the Globigerinina genera (15 genus) can be observed.

CONCLUSION

From an analysis of the ranges of the Globigerinina genera, it appears that the Mesozoic-Cenozoic boundary and the Paleogene-Neogene boundary are marked by a major break, characterized by abnormally high rate of extinction of the Globigerinina genera, followed by the appearance of new genera.

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دراسة تحليلية للمدى الأستراتيجي لأجناس تحت رتبة الجلوبيجريينا التابعة للفورامينفرا وتأثيرها على الحد الفاصل بين العصر الطباشيري والعصر الثالث

وجدي زكي محمد الديب

نتيجة عمل دراسة تحليلية للمدى الأستراتيجي لأجناس تحت رتبة الجلوبيجريينا التابعة للفورامينفرا ، أتضح أن الفترة الزمنية الممتدة للحد الفاصل بين العصر الطباشيري والعصر الثالث وكذلك بين فترة الباليوجين وفترة النيوجين مميّزه بمعدل مرتفع غير عادي من انقراض لأجناس الجلوبيجريينا متبوع بظهور عدد آخر من الأجناس الجديدة وذلك نتيجة لتغير الظروف البيئية والمناخية لها خلال هذه الفترات .