

EXTENDED PERIOD OF K/T BOUNDARY MASS EXTINCTION IN THE MARINE REALM; G. Keller, Dept. of Geological and Geophysical Sciences, Princeton University, Princeton, New Jersey 08544

The Cretaceous/Tertiary (K/T) boundary mass extinction has been widely recognized as a nearly instantaneous catastrophe among marine plankton such as foraminifera. However, the suddenness of this extinction event may have been overemphasized because most pelagic K/T boundary sequences are stratigraphically incomplete and generally lack the earliest Tertiary (Zones P0 and P1a) either due to carbonate dissolution and/or non-deposition. Stratigraphically complete sections appear to be restricted to continental shelf regions with high sedimentation rates and deposition well above the CCD. Such sections have been recovered from El Kef, Tunisia (1) and Brazos River, Texas. Quantitative foraminiferal analysis of these sections indicate an extinction pattern beginning below the K/T boundary and ending above the boundary. These data imply that the mass extinction event was not geologically instantaneous, but occurred over an extended period of time.

Stratigraphically the most complete section has been recovered from El Kef, Tunisia (1). At this location the K/T boundary is marked by an abrupt lithologic change from a white-grey marl to a 50 cm thick black clay layer containing an average of 5% carbonate. At the base of the black clay is a 2-3 mm thin rust colored ferruginous layer containing less than 1% CaCO₃, a maximum in TOC (~5%), and positive anomalies in Ir and Os (2). This thin ferruginous layer is likely to represent the hypothesized impact event.

Figure 1 illustrates planktic foraminiferal species extinctions and geochemical signatures across the K/T boundary at El Kef, Tunisia. Major changes in the geochemical data of Figure 1A precisely correlate with the lithological break that marks the K/T boundary and therefore imply a geologically instantaneous event. In contrast, species extinctions occurred over an extended time period with 36 species or 78% of the total planktic foraminiferal fauna extinct and ten species surviving (Fig. 1B). The order of extinction is: 6 species (13%) 25 cm below the boundary, 8 species (17%) 5 cm below, 12 species (26%) at the K/T boundary and 10 species (22%) 7 cm above the boundary. In addition, 6 species disappeared in the 4 m below this extinction interval; these are considered background extinctions.

There appears to be a non-random selectivity in the planktic foraminiferal extinctions with large complex species going extinct earlier than smaller more primitive morphologies. For instance, the early disappearance of large biserial to multiserial forms is followed by globotruncanid species and subsequently by the smaller robust rugoglobigerinids and finally by the simpler biserial pseudotextularids. The small biserial heterohelicids, as well as some globigerinellids, hedbergellids and guembelitrids survived longest and appear to have been best adapted for survival. This pattern of extinction is unlikely due to random extinctions, but implies a progressive systematic disruption of habitats with pre-K/T boundary extinctions unrelated to the boundary event.

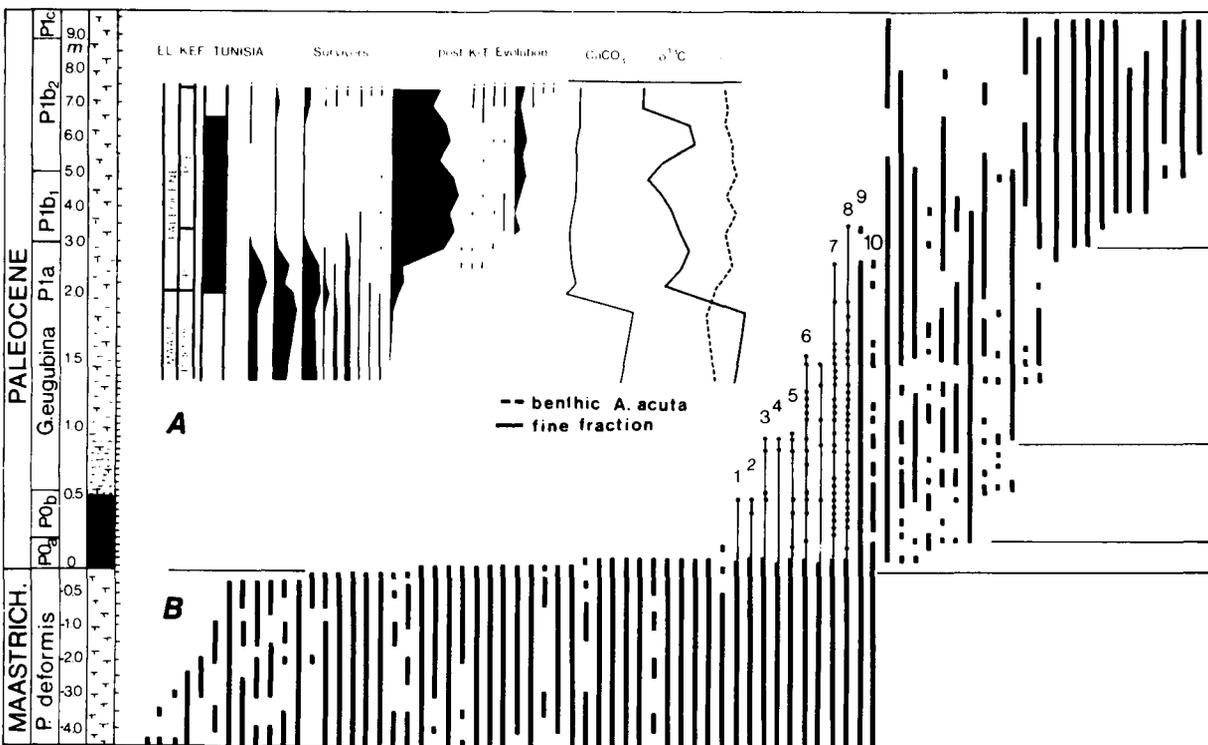
A similar pattern of species extinctions across the K/T boundary has been observed in sections from Brazos River, Texas where major extinctions begin about 1.6 m below the K/T boundary. Paleomagnetic control places the onset of the extinction interval in the uppermost part of Anomaly 30, or about 0.8 to 1 m.y. before the K/T boundary event.

The same ten species survive the K/T boundary event at El Kef and Brazos River, their extinction occurs near the top of Zone P1a or top of Anomaly 29r. However, there is a significant difference in the relative population abundances of the surviving species between

Tunisia and Texas. In Tunisia species populations decline soon after the K/T boundary event (Zone P0), whereas in Texas high population abundances persist into Zone P1a.

Thus, faunal and geochemical data from El Kef and Brazos River indicate (1) an extended period of mass extinctions beginning before the K/T boundary and (2) a geochemically instantaneous event (extraterrestrial impact?) at the K/T boundary. Although the onset of the mass extinction appears to have been related to global climatic changes, the extended period of mass extinctions beginning before the K/T boundary and (2) a geochemically instantaneous event (extraterrestrial impact?) at the K/T boundary. Although the onset of the mass extinction appears to have been related to global climatic changes, the K/T boundary event hastened the demise of a fauna already on the decline.

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Smit, J., *Geol. Soc. Amer. Special Paper 190*, 329-352 (1982).
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- (2) Kuslys, M. and Krahenbuhl, U., *Radiochimica Acta*, 34: 139-141 (1983).
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- A. Cretaceous survivors and post boundary evolution of planktic foraminifers, carbonate and carbon-13 data across the K/T boundary at El Kef, Tunisia
- B. Species ranges of planktic Foraminifers at El Kef, Tunisia. Species extinctions begin 25 cm below the K/T boundary and continue to 7 cm above the boundary. Ten Maastrichtian species survive into the Danian.

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