

PLANT MICROFOSSIL RECORD OF THE TERMINAL CRETACEOUS  
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Plant microfossils, principally pollen grains and spores produced by land plants, provide an excellent record of the terminal Cretaceous event in nonmarine environments. The record indicates regional devastation of the latest Cretaceous vegetation with the extinction of many groups, followed by a recolonization of the earliest Tertiary land surface, and development of a permanently changed land flora. The regional variations in depositional environments, plant communities, and paleoclimates provide insight into the nature and effects of the event, which were short-lived but profound.

Since the first discovery of the iridium anomaly at the Cretaceous-Tertiary boundary in a nonmarine section (1), the boundary has been documented at 30 or more localities from New Mexico to Alberta (2-14), a distance of about 2100 km. At all of these localities the boundary was identified by the pollen extinction horizon in association with the iridium anomaly and, at most localities, shock-metamorphosed minerals are present. Coal deposits are present at all these localities; the microfossils and boundary materials are preserved only in these low-energy, reducing environments. The boundary horizon is below, within, above, or at some stratigraphic distance from the coal beds at different localities.

The most significant aspect of the plant microfossil record in all areas studied is the abrupt disappearance of typical Cretaceous forms, primarily pollen of flowering plants. The latest Cretaceous vegetation varied gradually and continuously in composition from south to north as shown by varied plant microfossil assemblages, yet the extinction event affected all plant communities simultaneously. The evidence indicates that as much as one third of the flora became extinct as a consequence of the terminal Cretaceous event. Thus the plant microfossil record does not support the concept of mass extinction at the Cretaceous-Tertiary boundary. The response of land plants to the terminal Cretaceous event perhaps differed from that of other fossil groups because plants are capable of regeneration from rootstocks or seeds. In some large groups that were drastically affected by the event, a few species persisted into the earliest Tertiary only to finally become extinct. Some lineages appear to have been unaffected.

At most localities in the U.S. and in part of southern Canada, plant microfossil assemblages just above the boundary are characterized by anomalous abundances of fern spores (1, 5-9, 12, 14). The fern-spore "spike" has been defined as an unusually high relative abundance of spores with dominance by only one of a few species at each locality (5, 14). This unique microfossil assemblage represents recolonization of an apparently nearly barren landscape by opportunistic plant species. Initial colonization of a devastated land surface by ferns has been observed on smaller scales in historic times.

The continental scale of the earliest Paleocene fern dominance is a unique bioevent in the geologic record that demonstrates the catastrophic nature of the terminal Cretaceous event in the terrestrial realm.

Dominance of earliest Tertiary vegetation by ferns over much of western North America was followed by reestablishment of communities dominated by surviving flowering plants (or locally by conifers). As was true of the latest Cretaceous, the early Paleocene vegetation varied in composition with paleolatitude but was everywhere characterized by a substantial reduction in diversity and the eventual rise to dominance of a permanently reorganized flora. Few if any entirely new plant groups were present in these new communities until well into the early Paleocene. Plant groups that were present but relatively uncommon in the Cretaceous floras assumed new roles of prominence in the new communities of the Paleocene. Earliest Paleocene plant microfossil assemblages tend to be dominated by a few species of pollen of flowering plants that reflect a succession of differing communities of low diversity. The pollen record shows diversification of typical Paleocene lineages as elements of the modern flora developed.

The plant microfossil data support the hypothesis that an abruptly initiated, major ecological crisis occurred at the end of the Cretaceous. Disruption of the Late Cretaceous flora ultimately contributed to the rise of modern vegetation. The plant microfossils together with geochemical and mineralogical data are consistent with an extraterrestrial impact having been the cause of the terminal Cretaceous event.

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