PLANT MICROFOSSIL RECORD OF THE TERMINAL CRETACEOUS
EVENT IN THE WESTERN UNITED STATES AND CANADA; D. J. Nichols and

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.