THE FERN-SPORE ABUNDANCE ANOMALY AT THE CRETACEOUS-TERTIARY BOUNDARY: A REGIONAL BIOEVENT IN WESTERN NORTH AMERICA

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Abstract: At most localities where the palynological Cretaceous-Tertiary (K-T) boundary has been located in continuous deposition sequences in nonmarine rocks, an anomalous abundance of fern spores occurs immediately above the boundary. The fern-spore anomaly is characterized by unusually high relative abundance of fern spores and dominance by only one of a few species at each locality; it is independent of lithology. Its presence at the K-T boundary at localities from New Mexico to Saskatchewan is evidence of a regional bioevent in earliest Tertiary time: the overwhelming dominance of the continental flora by pioneer species following catastrophic destruction of existing plant communities by the terminal Cretaceous event.

INTRODUCTION

Bioevents are extraordinary changes in the Earth's biota that occur over relatively short periods of geological time and may be local, regional, or global in scale (Kauffman, 1986; WaUiser, 1986). Some bioevents are evidence of sudden, major disruptions that stressed or destroyed biological systems.

Palynological analyses of numerous Cretaceous-Tertiary (K-T) boundary sections from western North America have revealed a fern-spore abundance anomaly (FSAA) immediately above the K-T boundary claystone (Orth et al., 1981; Tschudy et al., 1984; Hotton, 1984; Nichols et al., 1985; Nichols et al., 1986; Bohor et al., 1987). Fig. 1 shows the geographic positions of general areas where the K-T boundary has been observed in nonmarine rocks at one or more locality and where the FSAA has been identified.

The FSAA is evidence of a bioevent that, in association with the extinctions of some land plants, the presence of shock-metamorphosed mineral grains, and anomalous concentrations of iridium at the same stratigraphic level, is consistent with the theory that the end of the Cretaceous was marked by the catastrophic impact of an extraterrestrial body. The FSAA provides insight into the nature of the effects of such an impact on continental ecosystems.

THE FERN-SPORE ABUNDANCE ANOMALY

Fern-spore relative abundances for three K-T boundary sections are shown in Fig. 2. These sections display the pattern of anomalous increase in relative abundance of fern-spores typical of the FSAA. In all three sections, the K-T boundary is defined by the extinction of characteristic species of Cretaceous palynomorphs. In these sections, fern-spore percentages in underlying Cretaceous rocks do not exceed 40% of the total palynoflora. Just above the K-T boundary, fern-spore percentages increase abruptly to high values. Fern spores return to normal percentages in higher samples. As can be seen in Fig. 2, the FSAA occurs at the base of, within, and at some stratigraphic distance from coal beds, and thus is independent of lithology.

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The FSAA is an unusual palynological assemblage in comparison with typical Upper Cretaceous and Paleocene palynological assemblages found in nonmarine rocks. Comparison of FSAA assemblages from numerous localities in the areas shown in Fig. 1 with typical assemblages reveals that the FSAA is characterized by: (1) unusually high relative abundance of spores, ranging from 70% to almost 100% of the assemblages (in contrast with 10% to 40% for typical Upper Cretaceous and Paleocene assemblages in the same sections); (2) dominance of the FSAA assemblage at each locality by only one of a few species; (3) restriction of the anomaly to a layer 0-15 cm above the K-T boundary (usually only a few cm above the boundary); (4) independence of lithology (the anomaly occurs in coals, carbonaceous shales, and mudstones); and (5) isochronity (based on palynological and geochemical evidence) and widespread distribution (from northern New Mexico to south-central Saskatchewan, a distance of approximately 1350 km). Because of its unique taxonomic composition, relatively short persistence in the stratigraphic record, and widespread distribution at an instant in time, the FSAA at the Cretaceous-Tertiary boundary is an excellent example of a bioevent.

**DISCUSSION**

The scale of bioevents can be local, regional, or global. Regional bioevents extend between sedimentary basins within a major craton (Kauffman, 1986). The FSAA occurs in the Raton basin in Colorado and New Mexico, the Powder River basin in Wyoming, and the Williston basin in Montana and Saskatchewan. This distribution suggests that the FSAA is a regional bioevent. Whether or not the FSAA extends beyond this