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Mass extinctions, recovery and resilience

Rapid ecological succession of pioneering fern species at the John's Nose Cretaceous–Paleogene boundary section (North Dakota, USA)

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Southwestern North Dakota offers some of the best terrestrial Cretaceous–Paleogene (K–Pg) boundary exposures, associated with many plant and vertebrate fossils. The John's Nose section, North of Marmarth, exhibits an organic-rich shallow lacustrine mudstone sequence that preserves a white, 2-3-cm-thick boundary claystone. We have conducted an unprecedentedly high resolution (1 cm) palynological sampling of the boundary interval. The onset of the boundary clay is associated with the sharp extinction of typical Cretaceous palynomorphs (K-taxa, from 20-30% total abundance down to <1%). Immediately above the boundary clay, we observe evidence for a rapid and sequential recolonization of the devastated landscape by pioneer species. Fern spore species typical of the K–Pg « fern spike » appear first (Cyathidites spp., ∼80%, then Laevigatosporites spp., ∼40%), followed by Deltoidospora spp. (∼20%), Reticuloidosporites pseudomurii (∼11%), and Gleicheniidites spp. (∼9%). Two disaster angiosperm taxa are also spiking within the same interval (Kurtzipites circularis, ∼11%, and Ullmipollenites krempii, ∼8%). This ecological succession of ferns is similar to those observed today following disturbances associated with landslides, wildfires, lava flows and human deforestation, in which different ferns species replace each other over a ∼100-year time span. In light of these similarities in both tempo and ecological signature, we propose that the K–Pg vegetation dynamics and associated impact on faunas could serve as a methodological model to better understand the impact of anthropogenic landscape disturbances.