Reconstructing Post Cretaceous/Paleogene Boundary Climate and Ecology at Mid-Waipara River and Branch Stream, New Zealand

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The Cretaceous-Paleogene (K/Pg) boundary marks a catastrophic global extinction event. Whilst the extent of mass extinction is well documented, there is ongoing debate about the immediate and longer term climatic and environmental changes triggered by the event. Several records of the K/Pg boundary are present in the northern South Island of New Zealand, representing a range of terrestrial and marine environments. Previous studies of terrestrial palynomorphs and siliceous microfossils from these sections suggested significant cooling and terrestrial vegetation reconfiguration in the earliest Paleocene. Extinctions or local disappearances of thermophilic taxa at the K/Pg boundary are consistent with the hypothesis of a short-lived "impact winter".

The Mid-Waipara (MW) K/Pg boundary section, north Canterbury, has been identified as suitable for organic geochemical study because sufficient organic carbon is present in the siliciclastic sediments and is thermally immature. Sediments were deposited in outer shelf to upper slope depths under a neritic watermass. New estimates of sea surface temperature (SST) variation based on TEX_{86} elucidate the relationship between biological and climatic changes that followed the K/Pg event.
Within the 0.25 m-thick interval identified as the "fern spike" in basal Paleocene sediments in this section there is no indication of a significant change in SST relative to the Cretaceous (22–25°C). Foraminiferal and radiolarian biostratigraphy indicates that this interval spans ~100 kyrs and includes a fern succession from colonising ground ferns to tree ferns, the latter suggesting a temperate, humid climate. The transition from ferns to a conifer-dominated pollen assemblage corresponds with a remarkable decrease in TEX_{86} values. These cooler SSTs persist over 10 m, throughout which the dominant conifer pollen type is *Phyllocladites mawsonii*, indicative of cool-temperate conditions. Preliminary biostratigraphic correlation suggests that this interval is condensed, possibly truncated at the base, and may be correlated to a more expanded biogenic silica-rich interval in the pelagic K/Pg boundary sections in eastern Marlborough, northeastern South Island including Branch Stream section. These results support siliceous microfossil evidence for pronounced cooling in early Paleocene in New Zealand.

Organic biomarker records provide further insight into terrestrial and marine ecological reconfiguration through the K/Pg boundary transition at MW. Major reorganisations of the phytoplankton and archaeal communities are indicated by pronounced changes in sterol and tetraether distributions following the K/Pg boundary. Transient disruption of terrestrial higher plants at the boundary is verified by suppression of *n*-alkane and triterpenoid concentrations, succeeded by a gradual recovery into the Early Paleocene. Furthermore, we investigate this disruption using compound specific stable carbon isotope analysis of *n*-alkanoic acids preserved in both sections. The scenario envisaged may be summarised as climate instability following the K/Pg boundary event, culminating in cool climatic conditions and a strengthened local upwelling regime leading to widespread deposition of diatom-rich siliceous sediments, lasting for around 1 Myr.