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# THE CRETACEOUS-TERTIARY BOUNDARY MARINE EXTINCTION AND GLOBAL PRIMARY PRODUCTIVITY COLLAPSE ;

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The extinction of marine phyto- and zoo-plankton across the K/T boundary has been well documented in studies of pelagic sediments from DSDP cores and land-based sequences.[1,2] Such an event may have resulted in decreased photosynthetic fixation of carbon in surface waters and a collapse of the food chain in the marine biosphere. Because the vertical and horizontal distribution of the carbon isotopic composition of total dissolved carbon (TDC) in the modern ocean is controlled by the transfer of organic carbon from the surface to deep reservoirs, it follows that a major disruption of the marine biosphere would have had a major effect on the distribution of carbon isotopes in the ocean. Negative carbon isotope excursions have been identified at many marine K/T boundary sequences worldwide[3-7] and are interpreted as a signal of decreased oceanic primary productivity. However, the magnitude, duration and consequences of this productivity crisis have been poorly constrained.

On the basis of planktonic and benthic calcareous microfossil carbon isotope and other geochemical data from DSDP Site 577 located on the Shatsky Rise in the north-central Pacific, as well as other sites, we have been able to provide a reasonable estimate of the duration and magnitude of this event. Site 577 was hydraulically piston cored and yielded a continuous, undisturbed sequence of pure nannofossil ooze across the K/T boundary. The boundary occurs at a relatively shallow burial depth of 109 m. From stable isotopic analyses of Site 577 planktonic and monogeneric benthic calcareous microfossils we have been able to reconstruct surface- to deep-water carbon isotope gradients for the Late Cretaceous and Early Tertiary Pacific. The record shows that the surface to deep water $\delta^{13}C$ TDC gradient disappeared at the time of the main plankton extinctions (Fig. 1) and that the gradient was not reestablished until $0.5 \times 10^6$ y following the event. $\delta^{13}C$ differences between various genera of Maestrichtian benthic foraminifera, which are interpreted to represent pore-water carbon-isotopic gradients related to in-situ decay of organic matter, also disappear at the K/T boundary (Fig. 1). We attribute these changes in carbon-isotope patterns to a rapid and substantial decrease in oceanic primary productivity.

Other evidence to support this interpretation includes: 1.) an average 4-fold decrease in biogenic $CaCO_3$ accumulation rates across the boundary despite improved preservation of calcite above the boundary [7]; 2.) a comparable decrease in the flux of Barium to the sea floor, an element which may be a proxy for organic matter[8]. These trends have been recognized at all K/T boundary sequences studied[7].

These data raise intriguing questions about the very nature of extinctions. Specifically, why did oceanic primary productivity apparently remain suppressed for greater than $0.5 \times 10^6$ y ? Is this the normal recovery time for the ecosystem following a mass extinction or were there external factors suppressing productivity? The oxygen isotope records from our studied sequences show no major long term change in temperature, although the earliest Paleocene marine climate appears to be relatively unstable in comparison with that of the latest Cretaceous.

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Figure 1.