The Cretaceous/Paleogene (K/Pg) boundary impact event: no global collapse of export productivity

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The K/Pg impact event caused mass extinction of oceanic calcifying plankton, probably at least in part due to darkness. The extinction of calcifying photosynthesizers (calcareous nannoplankton) has been seen as indicative of a collapse of all oceanic primary productivity ('Strangelove Ocean' model), or of vertical transport of organic matter (i.e., the biological pump, 'Living Ocean' model), as reflected in the collapse of vertical carbon isotope gradients. Evidence from organic biomarkers, however, indicates a rapid recovery of primary productivity, and non-calcifying phytoplankton did not suffer extreme extinction. Populations of benthic foraminifera are strongly coupled to surface productivity in the modern oceans, but did not suffer significant extinction. There is thus considerable evidence that the K/Pg extinction did not result in global collapse of export productivity on time scales of 10^5 years.
In order to assess the evolution of export production across the K/Pg boundary, we analyzed stable isotopes and benthic foraminifera in the same samples from ODP and DSDP sites in the Pacific, SE Atlantic and Southern Oceans.

Benthic foraminiferal accumulation rates and species relative abundances indicate that directly after the impact organic matter export declined but persisted in the SE Atlantic and Southern Oceans, and temporarily increased in the Pacific, although the carbon isotope gradient in these same samples collapsed. A rapid recovery of marine productivity in terms of biomass is thus compatible with benthic foraminiferal proxies for export production, the lack of significant extinctions among benthic foraminifera, and evidence from organic biomarkers. We argue that the collapse of vertical $\delta^{13}C$ gradients should not be interpreted as reflecting collapse of global export productivity: the extinction of calcifying phytoplankton may have been, at least in part, caused by surface ocean acidification resulting from the impact, and is not indicative of overall phytoplankton extinction. The carbon isotope records may have been severely affected by the mass extinction of the surface-dwelling carriers of the isotope signal (nannoplankton and planktic foraminifers), the increased abundance of isotopically light calcareous dinocysts, and changes in relative strength of the biological and solubility pumps in the oceans. The recovery of oceanic productivity in terms of biomass thus may have occurred on the same time scale as terrestrial productivity.