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How soon was food delivery to the sea floor restored after the Cretaceous/Paleogene plankton extinction?

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At the Cretaceous/Paleogene boundary deep-sea benthic foraminifera, in stark contrast to planktic forms, did not suffer significant extinction, but their assemblages underwent temporary restructuring commonly attributed to collapse of the pelagic food web. It seems improbable that such minor net changes could have been the response to a major, several-million-year-long, collapse of oceanic productivity and the 'biological pump' ("Strangelove Ocean"), as suggested by the collapse of the gradient in carbon isotope values between benthos and plankton (foraminiferal and/or bulk carbonate). Productivity (in terms of biomass, not diversity) could have recovered as soon as light returned after the impact: calcareous nannoplankton suffered severe extinction, but diatoms and prokaryote photosynthesizers survived, and the dinoflagellate calcareous cyst *Thoracosphaera* bloomed post-extinction. The extinction of some groups lessened competition for nutrients, with blooms of survivors leading to local/regional anoxia (*e.g*., Southern Spain). The lack of benthic-plankton gradient in carbon isotope records persisted for several millions of years, suggesting that transfer of organic matter to the sea floor (thus benthic foraminifera) remained low as the result of extinction of fecal pellet producers and/or a shift to smaller-celled primary producers ('living ocean model'; d'Hondt *et al.*, 1998). The lack of extinction of benthic foraminifera, however, argues for a faster recovery of both productivity and food transfer to the sea-floor. Transport of organic matter to the sea-floor may have recovered, because other processes of transport to the sea-floor than incorporation in fecal pellets may have worked, such as coagulation of organic particles by sticky diatoms and cyanobacteria, various methods of ballasting with biogenic silica or terrigenous dust. If atmospheric CO_2 levels were high after the impact, decreased calcification of the surviving calcareous nannoplankton may have led to increased delivery of organic matter to the sea floor because of increased formation of sticky polysaccharides. A rapid recovery of both productivity and the carbon pump leaves the persistent collapse of benthic-planktic carbon isotope gradients to be explained. First, light carbon isotope values in bulk carbonate and planktic foraminiferal tests, reflecting the carbon isotope values of total dissolved carbon in surface waters, may not represent a drop in productivity. A negative carbon isotope anomaly has also been observed in terrestrial materials, indicating that a marine-productivity explanation is not sufficient. The excursion to lower values might (at least in its early, more extreme part) have been caused by an input of light carbon in the surface ocean-atmosphere system (not penetrating into the deep sea), either as the result of biomass burning or by methane liberated from dissociation of gas hydrates due to massive slumping on continental margins. Second, at least part of the surface isotope signal may reflect ‘vital effects’. The carbon isotope values reflecting isotope values of total dissolved carbon in surface waters must by necessity be measured on calcareous nannofossils (bulk records) and/or planktic foraminifera. Both groups underwent severe extinction, so that post-extinction records are derived from different species than the pre-extinction records. Post-extinction calcareous nannoplankton is dominated by bloom species such as *Thoracosphaera*, and related Cretaceous and Recent species have light carbon isotope signatures.Third, the bulk record at some sites may be affected by diagenesis, as common in low-carbonate sediments. The three possibilities are not mutually exclusive, and the Cretaceous/Paleogene surface-bottom carbon isotope gradient collapse thus may reflect a more complex signal than one of collapsed productivity only. If both productivity and food transfer to the deep sea floor recovered faster than assumed earlier, the recovery of marine ecosystems (as to biomass, not as to diversity) would be similar to the rapid recovery postulated for terrestrial ecosystems.