Latest Paleocene deep-sea extinction: A pre-anthropogenic super greenhouse?

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Deep-sea benthic foraminifera (unicellular organisms) exhibit slow evolutionary turnover, and did not suffer during the mass extinction at the end of the Cretaceous. But about 55.5 million years ago 30-50% of their species became extinct over a few thousand years [*Thomas & Shackleton,* 1995]. Worldwide, post-extinction faunas show evidence of carbonate dissolution (as do bottom-dwelling crustaceans — ostracodes; Steineck & Thomas, [1996]), as well as of low oxygen conditions in many regions [*Thomas,* in press]. During the extinction global deep waters and high-latitude surface waters warmed by 3-4°C, remaining warm for 50-200 thousand years. Carbon isotope values of dissolved carbonate in surface and deep ocean waters and CO_2 in the atmosphere decreased by $\pm 2‰$ [*Kennett & Stott,* 1991; *Bralower et al.,* 1995]. Such a large carbon isotope anomaly can not have been caused by destruction of the land biomass (no evidence in fossils) or by injection of volcanogenic CO_2; it was so rapid that it can not have been caused by erosion of organic-rich sediment. A speculative scenario: volcanogenic CO_2 (North Atlantic Volcanic Province) warmed high latitudes, where surface waters reached a low density and could no longer sink to form intermediate-deep waters. They were replaced by warmer, salty waters derived from subtropical latitudes: the deep sea warmed, leading to dissociation of (carbon isotopically very light) methane hydrates [*Dickens et al.,* 1995]. Methane was oxidized, causing lower oxygen, carbonate corrosive conditions in the oceans and additional warming. Benthic foraminifera became extinct as a result of low oxygen, carbonate-corrosive conditions, as well as by possibly changes in locations of high productivity (upwelling) resulting from the changes in deep-water circulation [*Thomas,* in press]. ODP sites thus have given us information that short-term events suggestive of major climate instabilities can occur during warm periods of Earth history; additional research (e.g., Legs 165, 167) is expected to increase our insight in this extraordinary period.

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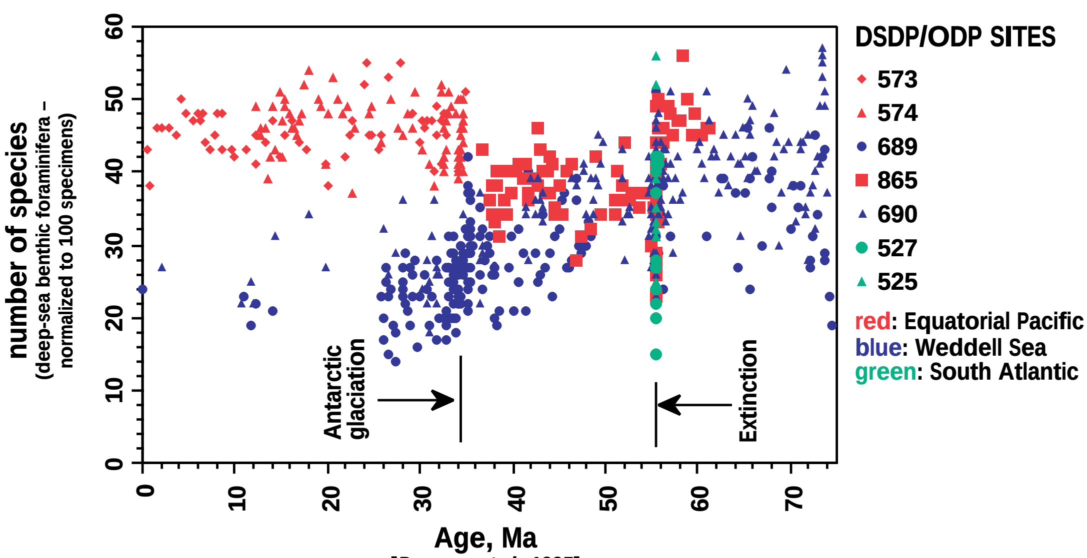

[*Berggren et al.,* 1995]