Ocean Acidification in Modern Seas and its Recognition in the Geological Record: The Cretaceous/Paleogene Boundary in Texas and Alabama

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ABSTRACT

With increasing atmospheric CO_2 the oceans are becoming progressively more acidic, with the lowered pH beginning to impact on the calcification of foraminifera, pteropods, calcareous nannoplankton and other invertebrate groups. Our work in the Mediterranean Sea, Gulf of California, Caribbean Sea, and elsewhere has shown how modern assemblages are responding to acidification. Around Ischia (Italy) natural seafloor CO_2 vents are creating a low pH environment in which it is possible to observe the response of benthic foraminifera. At a pH of 7.8, the assemblage is already becoming less diverse and below pH 7.6 there are no calcite-secreting benthic foraminifera. In the Gulf of California, in a deeper-water setting, natural CO_2 (and methane) vents are, again, lowering seafloor pH. The foraminifera show the impact of this change, although the relatively high carbonate saturation ensures that calcite-secreting foraminifera are able to live and reproduce in relatively low pH environments, only becoming impacted by dissolution effects once dead.

Using data from a number of global bioevents (Triassic/Jurassic boundary, Cretaceous/Paleogene boundary and the Paleocene/Eocene boundary) it is now possible to determine the contribution of acidification to global bioevents, both in the near-surface and in deeper-water environments caused by the migration of the carbonate compensation depth (CCD). In Texas and Alabama, the Cretaceous/Paleogene boundary successions record no direct evidence of ocean acidification despite the proximity to the Chicxulub impact site and the proposed source of some of the CO_2 (in addition to that from the Deccan Volcanic Center in India) required to cause the acidification. Interpretation of changes in the biota during global bioevents is complicated by the changing nature of the oceans through time, which have switched from being aragonitic to calcitic a number of times during the Phanerozoic. The other significant change is that from a 'Neritan Ocean' to a 'Cretan Ocean' in the mid-Jurassic.