RESPONSE OF MARINE AND FRESHWATER ALGAE TO NITRIC ACID AND ELEVATED CARBON DIOXIDE LEVELS SIMULATING ENVIRONMENTAL EFFECTS OF BOLIDE IMPACT; P.J. Boston[1], National Center for Atmospheric Research, Boulder, CO 80307 and EPO Biology Dept., University of Colorado, Boulder, CO 80309

One of the intriguing facets of the Cretaceous-Tertiary extinction is the apparently selective pattern of mortality amongst taxa (1). Some groups of organisms were severely affected and some remained relatively unscathed as they went through the K/T boundary. While there is argument concerning the exact interpretation of the fossil record (2,3,4,5,and 6), one of the best documented extinctions at the Cretaceous-Tertiary boundary is that of the calcareous nannoplankton (7). These organisms include coccolithic algae and foraminiferans. Attempts to explain their decline at the K/T boundary center around chemistry which could affect their calcium carbonate shells while leaving their silica-shelled cousins less affected or unaffected. Two environmental consequences of an extraterrestrial body impact which have been suggested are the production of large quantities of nitrogen oxides generated by the shock heating of the atmosphere and the possible rise in CO2 from the dissolution of $CaCO_3$ shells (8, and a recent reconsideration in 9). Both of these phenomena would acidify the upper layers of the oceans and bodies of freshwater not otherwise buffered.

In this study, the effects of nitric acid, carbon dioxide, or both factors on the growth and reproduction of calcareous marine coccoliths and non-calcareous marine and freshwater species of algae were considered. Cultures were grown in media with pH's ranging from 4.0 to 8.1 produced by the addition of nitric acid to the medium or by bubbling carbon dioxide through the medium, or both treatments at the same time. The two marine calcareous species tested suffered the most under these conditions compared to a marine siliceous species and four species of freshwater siliceous algae. Freshwater diatoms were least affected. Adverse physiological changes included a sharp decline in the ability to take up glucose below pH=6.2 for the calcareous and siliceous marine species and below 5.5 for freshwater species. For the freshwater species, shell-twinning occurred more frequently at low pH's but growth measured by dry weight and cell count was not substantially impaired for three of the four species. For calcareous species, dry weight and cell counts declined with time and degree of acidity. In addition, deformed shell plates occurred with increasing frequency and diminished capacity to replace them as the experiments progressed. This culminated in the eventual

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cessation of reproduction with naked protoplasts of algae predominating and finally a significant degree of lysis. These phenomena were at least as extreme when some experiments were repeated at lower culture densities simulating more closely densities in nature.

These experiments demonstrate that nitric acid and carbon dioxide have significant effects on important aspects of the physiology and reproduction of modern algae representative of extinct taxa thought to suffered significant declines at the Cretaceous-Tertiary boundary. Furthermore, calcarous species showed more marked effects than siliceous species and marine species tested were more sensitive than freshwater species.

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