"Ocean Acidification: Ancient Events and the Future"

Lee Kump
Penn State

Current observations demonstrate that the pH and saturation state of the surface ocean with respect to calcium carbonate is declining, an unavoidable consequence of the marked increase in atmospheric CO_2 from fossil fuel burning. Laboratory and mesocosm experiments demonstrate that the ability of calcifying organisms to build their skeletons will be compromised by further acidification of the surface ocean.

Ancient episodes of apparently rapid buildup of atmospheric CO_2 have been proposed as ancient analogues for modern ocean acidification (OA). We have investigated two episodes, the Permian-Triassic mass extinction interval and the Paleocene Eocene Thermal Maximum. Both are characterized by strong evidence for geologically rapid warming and a buildup of atmospheric CO_2 but limited and controversial evidence for surface OA. Based on best estimates for the time scale of these events, we calculate rates of emission that peak at ca. 1-2 Pg of C per year. Modeling suggests that at these rates, severe OA should be avoided, and the limited geological evidence from the PETM and P/Tr are consistent with that. Slow additions can be accommodated by the "biological pump" that shuttles the carbon to the deep ocean, causing a shoaling of the calcium carbonate compensation depth. ; Modern rates of fossil fuel burning are 10 Pg C $y^{-}1$. Current estimates of the global biological pump strength are approximately 6 Pg C y^{-1}. Thus current fossil fuel burning rates are exceeding the ocean's ability to compensate; severe surface ocean acidification is predicted. The ancient may hold no analogue for the future.