Interpreting PETM surface ocean pH change as a function of carbon release rate

SANDRA KIRTLAND TURNER[12*], ANDY RIDGWELL[12] AND SARAH E. GREENE[2]

[1]Department of Earth Sciences, University of California, Riverside, Riverside, CA 92521, USA
[*]correspondence: sandra.kirtlandturner@ucr.edu
[2]School of Geographical Sciences, University of Bristol, Bristol BS8 1SS, UK

Recent geochemical evidence for a decline in surface ocean pH across the Paleocene-Eocene Thermal Maximum (PETM, ~56 Ma) is consistent with release of carbon to the atmosphere and oceans over a geologically rapid timescale [1]. Theoretically, constraint on the magnitude of pH change, along with the size of the carbon isotope excursion, should allow calculation of both the mass and isotopic composition of the carbon source. However, the magnitude of surface ocean pH decline also depends on the rate at which carbon was released to the atmosphere. Unfortunately, age control for records of the PETM fails to constrain the onset phase more precisely than between instantaneous and 20 kyr. Here we use an Earth system model to demonstrate the senstivity of surface ocean pH change to the rate of carbon release. We explore the impact on surface ocean pH of a range of possible emisisons scenarios by varying both the total mass and isotopic composition of the carbon source and the rate of release. We find that the sensitivity of surface ocean pH change to varying the duration of carbon input between 1 year and 10 kyr is approximately equal to the difference in pH change caused by doubling the total mass of carbon released. These results demonstrate that interpretation of pH records for the PETM is heavily dependent on assumptions implicit in age model construction.

[1] Penman, D.E., B. Hönisch, R.E. Zeebe, E. Thomas, and J.C. Zachos (2014), Rapid and sustained surface ocean acidification during the Paleocene-Eocene Thermal Maximum, *Paleoceanography*, **29**, 357-369, doi:10.1002/2014/PA002621