Source and magnitude of carbon release associated with the PETM

MARCUS GUTJAHR[12], PHILIP F. SEXTON[3], ANDY RIDGWELL[49], ELENI ANAGNOSTOU[1], PAUL N. PEARSON[5], HEIKO PÄLIKE[6], RICHARD D. NORRIS[7], ELLEN THOMAS[8] AND GAVIN L. FOSTER[1]

[1]National Oceanography Centre Southampton, University of Southampton, UK E.Anagnostou@noc.soton.ac.uk, Gavin.Foster@noc.soton.ac.uk

[2]GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany mgutjahr@geomar.de

[3]Centre for Earth, Planetary, Space & Astronomical Research, The Open University, Milton Keynes, UK Philip.Sexton@open.ac.uk

[4]Bristol University, School of Geographical Sciences, Bristol, UK andy@seao2.org

[5]Cardiff University, School for Earth and Ocean Sciences, Cardiff, UK PearsonP@cardiff.ac.uk

[6]Marum Centre for Marine Environmental Sciences, University of Bremen, Germany hpaelike@marum.de

[7]Scripps Institution of Oceanography, University of California, San Diego, La Jolla, U.S.A. rnorris@ucsd.edu

[8]Department of Geology and Geophysics, Yale University, New Haven CT, U.S.A. ellen.thomas@yale.edu

[9]Department of Earth Sciences, University of California, Riverside, Riverside, CA, U.S.A.

Given previously published carbon release estimates, the Paleocene-Eocene Thermal Maximum (PETM) is the closest geological analogue to current anthropogenic fossil fuel emissions. In addition to 5-6 ºC of surface warming, this ~56 Ma event was associated with pronounced ocean acidification, recently reported to amount to a drop in oceanic mixed-layer pH on the order of 0.3 pH units at central North Pacific Shatsky Rise [1].

Calculating the global carbon budget using observed $\delta^{13}C$ changes alone cannot reveal the source and amount of carbon released whereas changes in carbon compensation depth offer only a weak constraint. Therefore we use a new boron isotope based estimate of mixed layer pH from DSDP Site 401 (NE Atlantic) as a second, $\delta^{13}C$-independent constraint. We then employ these observational constrains in a time-dependent fashion using the GENIE Earth System Model to simultaneously 'invert' both (i.e., the $\delta^{13}C$ *and* pH) records. We use this data-model approach to determine, for the first time, the source of carbon and magnitude of atmospheric pCO_2 rise associated with this event.

[1] Penman, DE et al. (2014). *Paleoceanography* **29**, 357-369.