ICP 12 International Conference on Paleoceanography
UTRECHT the Netherlands 2016 August 29 – September 2

An Earth System model approach to tracing the PETM carbon and temperature anomaly through the oceans and into the sedimentary record

Sandra Kirtland Turner, *University of California, Riverside, United States of America (sandra.kirtlandturner@ucr.edu)*
Andy Ridgwell, University of California, Riverside, USA, and University of Bristol, UK

The Paleocene-Eocene Thermal Maximum (PETM, ~56 Ma), an abrupt, greenhouse gas-fueled warming event, is our best available analog for future CO2 release and warming. Knowledge of the PETM onset duration is crucial for making detailed comparisons with future climate change — from the severity of biotic impacts to the existence of significant carbon cycle feedbacks. Yet carbon injection triggering the PETM is variously thought to have occurred over a geologic instant to tens of thousands of years. Typically, these estimates of the onset duration rely on conventional sedimentary age models that are not ideal for resolving rapid events. Different durations of carbon input (or the rate of carbon injection if constraint is placed on the total mass of PETM carbon emissions) should, however, result in distinct records of environmental change. Here we use the Earth system model cGENIE to quantify the consequences of differing carbon input durations on the isotopic and temperature record of different carbon reservoirs. We trace how the isotopic signal and temperature rise is differentially imprinted within the atmosphere and ocean, and focus on patterns and causes of spatial and depth-dependent variation in the carbon isotopic anomaly and warming in the ocean. We then evaluate several age-model independent metrics for constraining the duration of PETM carbon release. In particular, we identify a characteristic relationship between the ratio of carbon isotope excursion sizes in dissolved inorganic carbon (DIC) and atmospheric CO2 and the duration of carbon emissions. To the extent that available isotopic data spanning the PETM constrain the size of the marine and atmospheric carbon isotope excursions, applying this empirical relationship suggests the component of carbon emissions that dominates the isotopic signal could be less than 3000 years.