Estimations of atmospheric CO_2 levels for Eocene Thermal Maximum 2 (ETM2) using stable carbon isotopic compositions of algal biomarkers

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Eocene Thermal Maximum 2 (ETM2) has been recognized as the second hyperthermal event after the Palaeocene – Eocene Thermal Maximum (PETM). Both are associated with a rapid injection of isotopic light carbon in the ocean-atmosphere system and, consequently, severe ocean acidification. Elucidation of the mechanisms of rapid global warming is important for understanding the climate dynamics in such warm climate regimes, which may serve as an analogue to present day climate change. Here we studied ETM2 sediments deposited on the Lomonosov Ridge in the central Arctic Ocean, which contained a relatively high abundance of sulfur-bound biomarkers derived from marine algae and cyanobacteria. We analyzed the carbon isotopic composition of these biomarkers to reconstruct isotopic fractionation factors. Using the concept that photosynthetic organisms tend to fractionate more in favour of light carbon under high CO2 conditions, pre-ETM2 pCO2 levels were estimated to be 4-5 times that of pre-industrial pCO2 levels. During the event itself, isotopic fractionation increased further indicating even more elevated pCO2 levels. Currently we are conducting similar analyses on off-shore PETM sections. The estimated changes in pCO2 levels for the PETM will then be compared with those reconstructed for the ETM2 event using the same biomarkers.