A high resolution compound specific carbon isotope study of the PETM in Northern Spain

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The Paleocene/Eocene Thermal Maximum (PETM) occurred approximately 55 Ma, lasting for 100–200 Kyr, initiating a period of global warming, biotic extinction, migration and turnover, and fundamental changes in the carbon and hydrological cycles[1] Marine and terrestrial sediments record the event, however discrepancy between the carbon isotope excursion (CIE) measured in the two realms has been observed ($\delta^{13}C$ marine 2.5–4‰, $\delta^{13}C$ terrestrial 6–8‰)[2,3,4]. Two hypotheses have recently been proposed for this discrepancy – the "marine modification" and the "plant community change" hypothesis[5]. The plant community change hypothesis states that the magnitude of the CIE is greater in the terrestrial realm owing to major changes in floral composition during the PETM from mixed angiosperm (flowering plants)/gymnosperm (conifers) flora, to a purely angiosperm flora [5,6].

To date, the plant community change hypothesis has been tested in North America and the Arctic. Presented here are preliminary results from eight sections in Northern Spain spanning the Paleocene/Eocene boundary. The sections from East to West are Claret, Tendrui, Esplugafreda, and Berganuy in the terrestrial realm, La Cinglera and Campo, which collectively represent a shallow marine setting, and Zumaia and Ermua, which are deep marine sections.

Total organic carbon (TOC) $\delta^{13}C$ along this transect illustrate that the CIE associated with the PETM varies in magnitude between ca. 2 and 5‰; however there appears to be no direct link between magnitude and depositional environment. Furthermore, due to the high resolution nature of the $\delta^{13}C$ data, the onset of the CIE at all sections can be assessed in more detail than could previously be achieved from the carbonate isotope record. Preliminary results from compound specific carbon isotope analyses of higher molecular weight *n*-alkanes from all 8 sections appear to support the bulk $\delta^{13}C$ data. However, the results suggest that the bulk $\delta^{13}C$ records a lower magnitude excursion than the *n*-alkane data in the northern Spain PETM sections, as excursions of up to 8‰ are being found in the *n*-alkane $\delta^{13}C$ data. This apparent enhancement in the magnitude of CIE is particularly significant when considering the average chain length results, as thus far they record no observable change in those sections analysed. This could suggest that there is no appreciable reconfiguration of terrestrial higher plant biota coincident with the PETM across Northern Spain, indicating that plant community change is not responsible for overestimation of the CIE in the sections analysed.

References:

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