# The carbon isotope stratigraphy of the PETM – new records from bacterial and higher plant biomarkers

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The Paleocene-Eocene Thermal Maximum (PETM) is one of the most dramatic climate events in Earth history, characterised by a negative carbon isotope excursion (CIE) in marine carbonate attributed to the release of methane from gas hydrates. Carbon isotopic records have also been obtained from terrestrial settings, and these are critical for defining the magnitude of the shift in atmospheric $CO_2$ $\delta^{13}C$ values. However, such records are limited in number and resolution. Here we use CSIA to extract terrestrial isotopic records from three mixed-source PETM sedimentary sequences: a NZ section (Kumara) deposited in deltaic to nearshore marine sediments; the Cobham lignite (England), deposited in a coastal margin flood-plain setting; and Tanzanian continental margin sediments.

In the Kumara section, the PETM is associated with a change in lithology and biomarker assemblages. The latter reflect more reducing conditions, a shift to marine deposition and increased angiosperm inputs. Thus, bulk organic isotopes record a mixture of sources and cannot be used to evaluate the PETM CIE; instead, *n*-alkane $\delta^{13}C$ values were used to identify a 4.5‰ excursion.

In the Cobham Lignite, a 4‰ negative shift occurs in bulk organic matter; as with Kumara, changes in lithology and organic matter source complicate interpretation of these values. However, higher plant *n*-alkane $\delta^{13}C$ values confirm the bulk organic isotope record. Moreover, the lignite contains high abundances of bacterial hopanes. Their $\delta^{13}C$ values prior to the excursion are consistent with a heterotrophic source, but at the excursion they decrease dramatically suggesting an origin from methanotrophs. Although restricted to a single site, this represents the first direct evidence for methane assimilation at the PETM, and the specific values (ca. -60‰) are consistent with previous estimates for hydrate-derived methane.