ALTERNATIVE EXPLAINATIONS FOR THE INITIAL ORGANIC CARBON ISOTOPE EXCURSION IN THE UK DURING THE END-TRIASSIC MASS EXTINCTION

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Five mass extinction events are recognised throughout the geological past with all but one associated with large igneous provinces. One such mass extinction event associated with intense volcanic activity is the end-Triassic mass extinction (ETE) that occurred ~201 million years ago[1]. One focal section in ETE studies is St. Audrie's Bay, UK. Here, the iconic organic carbon isotope record ($\delta^{13}C_{org}$) exhibits 'initial' and 'main' negative excursions[2], with similar isotopic patterns occurring in other European sections. These 'initial' excursions are typically attributed to the dissociation of methane clathrates that have very low isotopic signatures. This methane rapidly oxidises to CO_2 before subsequently being incorporated into organic matter and thus preserved in the sedimentary record[3–5]. St. Audrie's Bay is typically reported as a marine section. However, recent investigations indicate a marine to freshwater transition due to the presence of freshwater biota and periodic exposure due to the presence of desiccation cracks during the time of the 'initial' organic carbon isotope excursion. Other investigated UK sections including Whitehead, Lavernock, St. Mary's Well Bay and Lilstock also show initial $\delta^{13}C_{org}$ excursions that are similar to St. Audrie's Bay in both timing and magnitude. Evidence of a freshwater transition and periodic exposure is also found at these sections indicating that the St. Audrie's Bay $\delta^{13}C_{org}$ record and oligohaline record is characteristic of a very large area.

Biomarkers are the fossilised lipids that derive from the 3 domains of life that are able to serve as import proxies indicating changes in redox, environmental and ecological conditions during mass extinction events[1]. Hopanes (generally derived from bacteria) and steranes (largely derived from eukaryotes) investigated during the 'initial' $\delta^{13}C_{org}$ excursion at St. Audrie's Bay (Figure 1) suggest that the excursion may instead be the result of, or at least influenced by, local biotic community changes as a result of dramatic sea level drop and influx of freshwater. Steranes in the C_{26} to C_{30} range indicate that during the 'initial' $\delta^{13}C_{org}$ isotope excursion relative abundances of green algae increase whilst those of prasinophytes, chrysophytes, and red algae decrease. During this time, hopanes indicating redox conditions, unlike those in Canadian sections during the ETE[6], co-vary in opposite directions such that the homohopane index increases whilst the C_{28} 28, 30 bis*nor*hopanes decrease indicating increases in microbial activity and a change in microbial communities as a result of changing water depth respectively[7]. The greater abundances of hopanes compared to steranes during the 'initial' $\delta^{13}C_{org}$ excursion in what has already been determined a sub-oxic to aerobic environment[8] indicates greater bacterial activity in a freshwater to lacustrine environment. Furthermore, biomarkers of methanotrophs also decrease during the initial $\delta^{13}C_{org}$ excursion that may have expected to increase with the dissociation of methane clathrates. Interpretation of this data set suggests the initial $\delta^{13}C_{org}$ excursion results from bacterial community changes and increases in microbial activity due to fractionation differences between bacteria and eukaryotes. This data set also outlines the further need of multi-proxy biomarker investigations during mass extinction events and their recoveries.

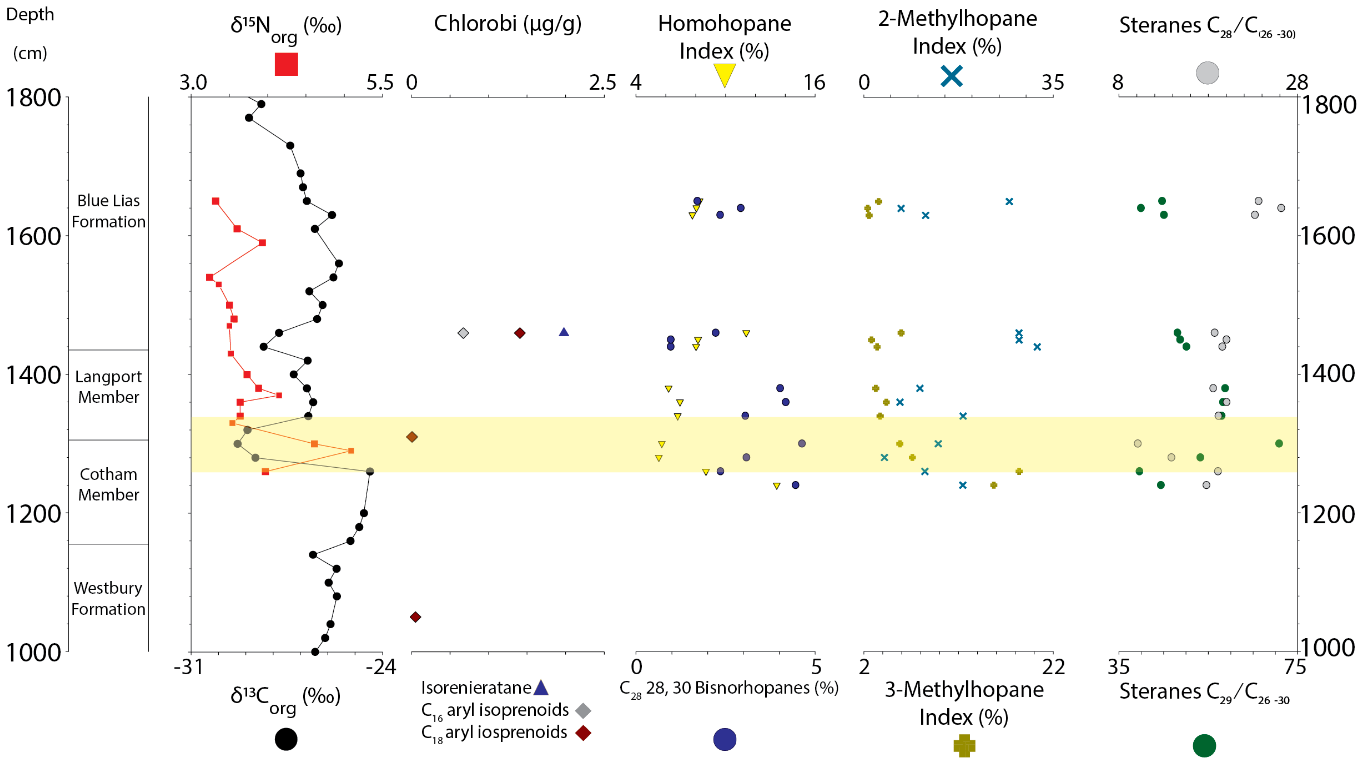

Figure 1. Biomarkers indicative of changing redox and ecological conditions with nitrogen[8] and carbon[2] isotope data and biomarkers of chlorobi indicating photic zone euxinic conditions[9]. Highlighted bar indicates the duration of the 'initial' carbon isotope excursion.

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