Evidence for strong seasonality in the shallow Tethys across the end-Triassic mass extinction

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The end-Triassic mass extinction coincided with the eruption of the Central Atlantic Magmatic Province, a large igneous province responsible for the massive atmospheric input of potentially climate-altering volatile compounds including a sharp rise in atmospheric CO_2. The extinction mechanism is debated, but both short-term cooling due to sulphur aerosols and long-term warming due to CO_2 emissions – essentially opposite hypotheses - are suggested triggers. However, no definitive temperature records spanning this crucial interval are available to differentiate between hypothesised mechanisms. In the uppermost Triassic of the southwest United Kingdom, a well-preserved deposit of stromatolitic carbonate (the Cotham Marble) occurs in the extinction interval. We apply clumped-isotope palaeothermometry to the Cotham Marble, revealing temperatures of carbonate formation that fluctuated between 30.1 ± 4.5°C and 15.2 ± 2.1°C – swings too large to be attributable to global climate change. Comparison with climate modelling suggests that these temperatures are compatible with a strong seasonal signal – results that constitute the oldest non-biomineralised marine seasonal temperature record. We resolve no apparent evidence for short-term cooling or initial warming across the extinction event.