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The first high resolution continental δ^{18}O isotopic record demonstrating a 'stepwise' transition into Oligocene icehouse conditions

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Isotopic analysis of shell fragments of the freshwater gastropod species *Viviparus lentus* from the fluvio-lacustrine Solent Group deposits of the Isle of Wight, Hampshire Basin, U.K, has produced a high resolution terrestrial δ^{18}O record. This record shows a stepwise shift into the Eocene/ Oligocene (E/O) transition, which is of a comparable resolution to marine records of this time period. Even though the earliest Oligocene glacial maximum (EOGM) itself appears to be missing due to a hiatus, our results suggest that there are a number of preceding isotopic shifts leading up to it, including continental representation of the 'Late Eocene Event' and also step 1 of the Eocene / Oligocene transition (Step 1 of Coxall *et al*., 2005: *Nature* 433*, 53-57*); EOT-1 of Katz *et al*.(2008: *Nature Geoscience* 1, 329-334). There is also a second isotopic step that immediately precedes the sedimentary hiatus which could, depending upon the duration of the brake in deposition, represent either the Eocene / Oligocene transition 2 (EOT-2) of Katz *et al*. (2008: *Nature Geoscience* 1, 329-334), or step 2 of Coxall *et al*.(2005: *Nature* 433*,* 53-57). This is the first time these events have been documented within the continental record.

Combining the bulk δ^{18}O isotope record with a new *Viviparus contectus* species specific thermometry equation and local water oxygen isotope values calculated by Grimes *et al*. (2005: *Geology* 33, 189-193) has allowed the calculation of palaeotemperature values at 6 distinct horizons. By assuming that the changes in the δ^{18}O of seawater, as reported by Katz *et al*. (2008: *Nature Geoscience* 1, 329-334), are also mirrored by changes in local water oxygen isotope values, palaeotemperatures for the intervening data points were also calculated. These results record a decrease in mean palaeotemperatures during the stepwise shift prior to the EOGM, but not across the event itself.

Micro-milled growth bands from whole well preserved *Viviparus lentus* specimens were also isotopically analysed to determine if there were any changes in seasonality across the EOGM. Minimum and maximum δ^{18}O values suggest that the decrease in mean palaeotemperatures prior to EOGM was controlled by a decrease in maximum summer temperatures. This confirms Coxall *et al*.(2005: *Nature* 433*, 53-57*) record, where a δ^{18}O increase in benthic foraminiferal calcite coincides with an eccentricity minimum and low-amplitude obliquity change which they argued favoured cool summers and promoted ice growth during step 1 of the Eocene / Oligocene transition. The occurrence of cooler winters post the EOGM is also suggested by our results and in line with the results reported by Ivany *et al*. (2000) *Nature*, 407: 887 - 890).