Coupling of marine and continental isotope records during the Eocene/Oligocene transition

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During the Cenozoic, conditions existed that allowed for the formation of permanent continental-scale ice caps on Antarctica (Miller *et al*., 1991; Zachos *et al*., 2001). Long-term cooling commenced after the Early Eocene Climatic Optimum (52 to 50 Ma), culminating in the Oi-1 glacial maximum (~33.65 Ma) (Miller *et al*., 1991; Zachos *et al.,* 2001; Bohaty and Zachos, 2003). This event reflects a transition from a greenhouse to an icehouse world and is recorded in the marine realm as a stepped positive $\delta^{18}O$ shift in benthic and planktonic foraminifera (Coxall *et al*., 2005; Katz *et al*., 2008; Pearson *et al*., 2008; Lear *et al*., 2008).

Reported here is a $\delta^{18}O$ record across the continental Eocene/Oligocene transition (EOT).
The record derived from *V. lentus* displays 3 cycles followed by a positive $\delta^{18}O$ shift across Oi-1 with subsequent recovery to pre-Oi-1 values. Within these cycles, plus across the isotope shift and recovery, $\delta^{18}O$ values change in magnitude between 1.4 – 1.8‰. If entirely due to temperature this would equate to a 6 – 13°C (depending on calibration) temperature variation, which according to its high magnitude, implies a contribution from another factor, such as changes in the isotopic composition of the host water in which *V. lentus* grew. The ultimate control on this is likely to be related to changes in global ice volume. The *V. lentus* $\delta^{18}O$ Oi-1 shift and recovery are comparable to that seen in the marine record. Furthermore, in cycle 1 the most positive $\delta^{18}O$ value corresponds with the Late Eocene Event as observed in the marine record. Cycles 2 and 3 together occupy the same time interval, recording successive positive $\delta^{18}O$ shifts in the marine realm. Moreover, the negative $\delta^{18}O$ peak between cycles 1 and 2, associated with biotic and isotopic evidence for warming, matches a marine calcite compensation depth shoaling event. Although the cycle 2 positive $\delta^{18}O$ peak has no equivalent in the marine realm, fluctuations within cycle 3 appear synchronous with the named events EOT1/Step 1 and EOT2 (Coxall *et al*., 2005; Katz *et al*., 2008; Pearson *et al*., 2008; Lear *et al*., 2008). Therefore, the $\delta^{18}O$ record from *V. lentus* in a coastal floodplain environment shows substantial similarities with those from benthic foraminifera in the marine realm across the EOT and Oi-1 in timing and trajectory. Combined with multiproxy isotope derived summer temperatures, sea-level change and biotic data, some patterns of climate change with respect to the relative roles of temperature and ice-volume in this continental record are also comparable with those documented in the marine record. This suggests that when sampling resolution allows, a coupling of the marine and continental isotope records through the EOT can be observed.

References:
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