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The Valanginian positive carbon-isotope event; a coupled organic and bulk carbonate 13C record from the western North Atlantic

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The Valanginian positive carbon-isotope excursion (∼135–138 Ma; also known as the "Weissert OAE") represents a major perturbation to the Early Cretaceous carbon cycle. This apparently global event has previously been documented in marine isotope records from the Tethyan region, the North Atlantic, Pacific and in a terrestrial isotope record from the Crimea. A bulk carbonate carbon-isotope ($\delta^{13}C_{carb}$) excursion of ∼+1.5 per mil, is seen in many of these records, often accompanied by a corresponding excursion of ∼+4 per mil in the bulk organic-matter ($\delta^{13}C_{org}$) record. Although the positive excursion is apparent in both $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ records, a lack of synchronicity between the two materials during both the onset of the excursion and the subsequent recovery period has been suggested. To date, this has been difficult to verify due to the low-resolution nature of existing $\delta^{13}C_{org}$ records.

Lithologically separated, coupled $\delta^{13}C_{org}$ and $\delta^{13}C_{carb}$ records from marine cores at two North Atlantic sites (DSDP Sites 534 and 603) were analysed. As previously documented, the excursion is clearly visible in the inorganic carbon-isotope record at these sites, but is now also evident in the bulk organic-matter record. A minor lag was observed between $\delta^{13}C_{org}$ and $\delta^{13}C_{carb}$ during the onset of the excursion, with both materials attaining peak positive values during the same interval within magnetochron M11. A longer duration lag exists between recovery of the $\delta^{13}C_{carb}$ values to pre-excursion values, in the Early Hauterivian, and the recovery of the $\delta^{13}C_{org}$ record, which does not occur until the mid Hauterivian. Such an offset raises questions regarding carbon cycling, as both records may be expected to reflect the $\delta^{13}C$ of seawater. However a change in the type and provenance of the organic matter preserved in these sediments with time, which would influence the bulk $\delta^{13}C_{org}$ record, cannot be discounted. A lithological control on stable-isotope ratios is also identified in both $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ records at these sites, which may help to explain much of the "noise" often seen in such records.