

Multi-proxy constraints on global carbon-cycle perturbations during the Early Aptian Oceanic Anoxic Event (OAE 1a)

LAWRENCE PERCIVAL¹, OLIVIA GRAHAM², JEROEN VAN DER LUBBE¹ AND DAVID NAAFS²

¹Vrije Universiteit Amsterdam

²University of Bristol

The Aptian Stage was marked by one of the most severe global carbon-cycle perturbations of the Mesozoic Era, associated with an interval of climate warming and widespread marine anoxia referred to as the Early Aptian Oceanic Anoxic Event (OAE 1a; 121 Ma). Stratigraphic archives of OAE 1a document both the increased input of carbon to the ocean-atmosphere system at the onset of the crisis, and subsequent enhanced burial of it in organic matter later in the event, based on negative and positive excursions, respectively, in the stable isotopic compositions of organic and inorganic carbon ($\delta^{13}\text{C}$). This sequence of excursions is often used to stratigraphically characterize sedimentary records of OAE 1a; however, some sites show $\delta^{13}\text{C}$ trends that deviate from those documented elsewhere. One such example is DSDP Site 398, which preserves a sedimentary record of OAE 1a deposited on the northern margin of the proto-Atlantic Ocean. At this site, $\delta^{13}\text{C}$ values of bulk organic matter show an atypical increase at the base of the assumed OAE 1a level, stratigraphically below the more usual signal of a negative excursion followed by one or more positive shifts. It is unclear whether this disparity marks a genuine regional–global carbon-cycle perturbation around the onset of OAE 1a, or results from one or both of mixing of multiple sources of organic material, and local processes superimposed on to the global carbon-cycle perturbation.

Analysing the $\delta^{13}\text{C}$ values of specific organic compounds or biomarkers can circumvent this issue and give a clearer insight into the global and/or local influences of carbon cycling at a particular site. Here, we present the stratigraphic trends in n-alkane $\delta^{13}\text{C}$ compositions across the OAE 1a level at DSDP Site 398, together with those of bulk organic and inorganic carbon. Combining these techniques can differentiate between global vs local influences on carbon cycling during OAE 1a at Site 398, and the stratigraphic context of this archive can be more tightly constrained. Additionally, comparing these datasets with pre-existing evidence for climate warming and volcanic activity at that site enables the trigger(s) and impact(s) of carbon-cycle disruption before and during OAE 1a to be refined.