

CORRESPONDENCE OF CRETACEOUS BLACK SHALES IN THE WESTERN NORTH ATLANTIC OCEAN TO GLOBAL OCEANIC ANOXIC EVENTS

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During the mid-Cretaceous (~124-90 Ma), organic-carbon-rich black shales were deposited along the continental margins and in basins of the widening North Atlantic in response to the development of dysoxic and anoxic conditions in oxygen minimum zones. Embedded within the black shales are Oceanic Anoxic Events (OAEs) that were generally short-lived (<1 Myr) episodes of organic carbon burial characterized by the widespread distribution of discrete beds of black shale and/or pronounced positive carbon isotopic excursions. Between two and seven mid-Cretaceous OAEs have been recognized. The two most widespread OAEs are the early Aptian OAE 1a (~120.5 Ma) and the Cenomanian-Turonian boundary OAE 2 (~93.5 Ma), both characterized by heightened marine productivity (type II kerogen) and positive $\delta^{13}\text{C}$ excursions. Other intervals include the late Aptian (~116 Ma), the early Albian OAE 1b (~112 Ma), the late Albian OAE 1c (~102 Ma), the late Albian OAE 1d (~99.2 Ma), and the Mid-Cenomanian OAE (MCE: ~

Ocean Drilling Program Leg 210 recovered an expanded and continuous mid-Cretaceous sedimentary sequence at Site 1276 in the Newfoundland Basin of the western North Atlantic Ocean in 2002. The cored sequence extends from the lowermost Albian to the Cenomanian-Turonian boundary and contains seven sedimentary intervals with high TOC contents that appear to record OAEs. These layers correspond to the Cenomanian-Turonian OAE 2, the Mid-Cenomanian Event, and the Albian OAE 1b, OAE 1c, and OAE 1d. Two additional Albian intervals with geochemical characteristics similar to OAE layers exist, even though they do not correspond to any of the known OAEs. We investigated the amount and origin of the organic matter contained within these black shale intervals using TOC and CaCO_3 contents, $\text{C}_{\text{org}}/\text{N}_{\text{tot}}$ ratios, organic carbon and nitrogen isotopes, trace metal compositions, and Rock-Eval analyses. The black shales that were identified as correlating with OAE 2 are characterized by organic matter of algal origin and by positive carbon isotope shifts. The sedimentary interval that might correspond to the MCE seems to be of marine origin with some admixture of terrigenous material. The black shales related to OAE 1b are characterized by organic matter of marine bacterial origin and by positive carbon isotope shifts. The intervals that coincide with OAE 1d and 1c are not particularly enriched in TOC

and seem to be dominated by detrital organic matter. Finally, OAE ?1 and ?2 are relatively enriched in marine organic matter, suggesting that these layers represent episodes of increased marine productivity although not obviously related to any known OAE. Furthermore, many of the Site 1276 black shale intervals exhibit low $\delta^{15}\text{N}$ values ($<0\text{‰}$) that reflect an altered nitrogen cycle having significantly higher rates of nitrogen fixation than in the Cenozoic ocean.

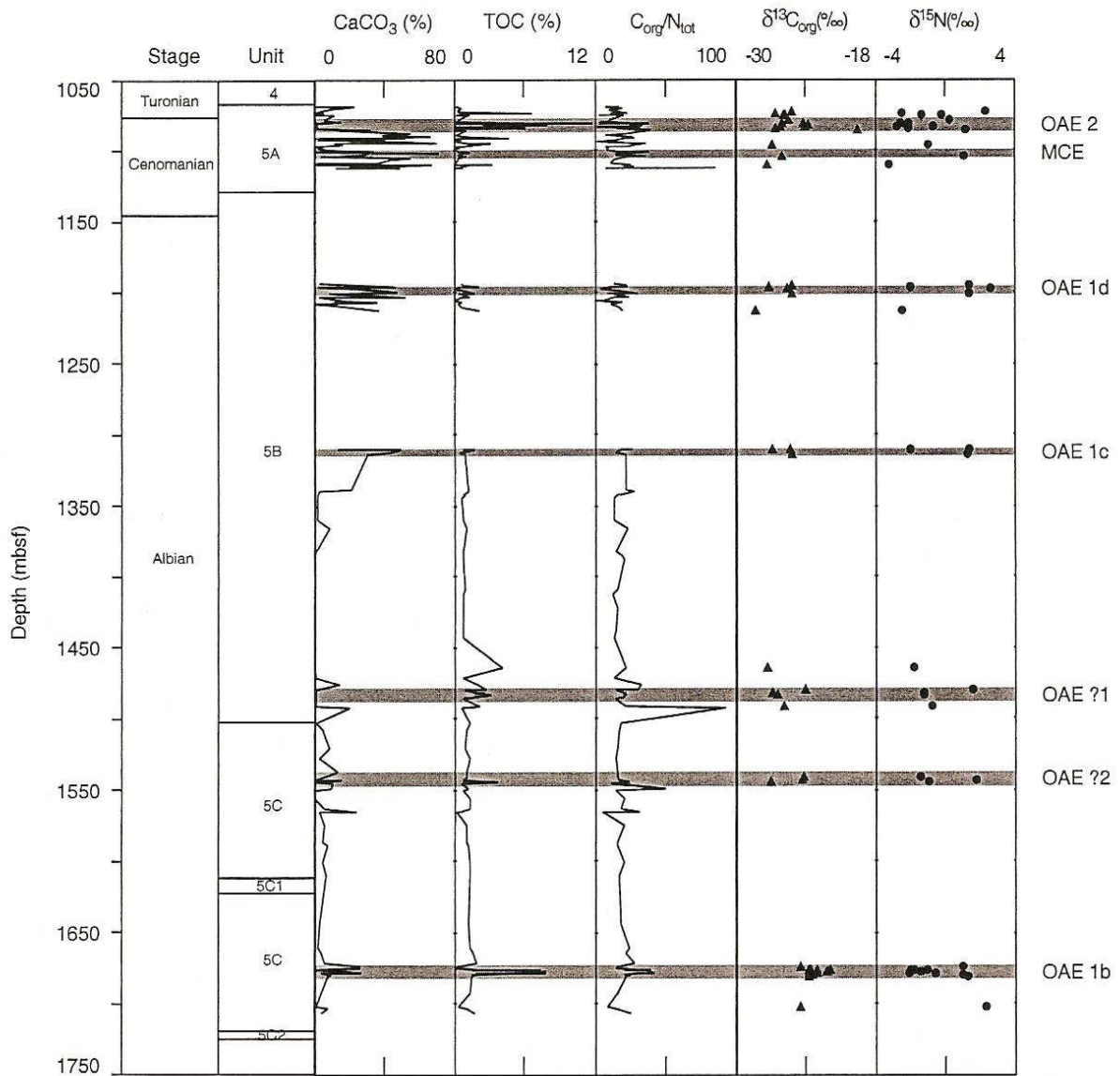


Figure 1. Concentrations of CaCO₃ and total organic carbon (TOC), atomic C_{organic}/N_{total} ratios, organic $\delta^{13}\text{C}$ values, and total $\delta^{15}\text{N}$ values that identify existence of Oceanic Anoxic Events (OAEs) in sediments of ODP Site 1276, Newfoundland Basin, western North Atlantic Ocean.