

Demise of OM-Rich Facies and Changing Environmental Conditions Associated with the End of Carbon Isotope Segment C5 Of OAE1a, South-Central Spanish Pyrenees

Jander Socorro¹, Florentin Maurrasse²

¹Florida International University; ²Florida International University

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Abstract

Coincident intervals of globally widespread OM-rich sediments, or oceanic anoxic events (OAEs), are important in the Cretaceous sedimentary record as global source of hydrocarbons. Our study investigates the response and timing of OM accumulation in an 85.82 m section of the northeastern Iberian margin during OAE1a. We integrate the recorded signals within a broader spatial frame to establish analogies that may help in assessing the regional expression superimposed on the global factors related to this event. Results from thermal maturity indices suggest that the sediments experienced conditions equivalent to the early oil window, thus the preserved organic geochemical data characterizes the original signal with minor to no alteration. Carbon isotope ($\delta^{13}\text{C}_{\text{org}}$) data mirror the pattern reported for the closure of segment C5 within OAE1a. The lower 24.72 m shows fluctuating terrestrially derived elements (Al, Si, Ti) indicative of fluvial pulses with marlstones recording episodes of highest terrigenous input concomitant with peaks in TOC, relatively lower benthic faunal counts, lower bioturbation index, higher concentration of pyrite and enrichments in RSTEs. These proxies reveal that intensified fluvial periods provided more biolimiting elements, which enhanced primary production of abundant labile OM conducive to oxygen-deprived conditions. The ensuing 57.17 m consists essentially of marlstones that show substantial increases in TOC, RSTEs, P, Fe, Al, Si, and Ti values indicative of strengthening runoff related to higher prevailing humid continental

conditions with greater delivery of biolimiting elements that further heightened primary productivity. Higher gammacerane index attests to a stratified water column, which may have been critical in preventing vertical mixing and oxygenation of the basin. The uppermost 3.93 m registers the demise of previous conditions with hard limestones low in TOC, Al, Si, Ti, P and Fe, and with lower ratios of autochthonous to allochthonous OM, indicating a reduction in fluvial fluxes and surface water fertility suggesting dryer climatic conditions. Changes in microfacies, with coarser grain packstones, fewer planktonic foraminifera and increase in benthic taxa, imply a shallowing of the basin, heralding the end of OM-rich sediments in the south-central Spanish Pyrenees Basin at the end of segment C5 similar to that reported for the neighboring Basque-Cantabrian Basin synchronous to the 2.76‰ negative $\delta^{13}\text{C}_{\text{org}}$ shift.