

Oscillating redox conditions in the Vocontian basin (SE France) during OAE 2 : Paleoenvironmental implications

JULIEN DANZELLE¹, LAURENT RIQUIER¹, FRANÇOIS BAUDIN¹, CHRISTOPHE THOMAZO², BENOIT CARON¹

¹UPMC-Paris VI, UMR 7193 IStEP

²UBFC, UMR 6282 Biogéosciences

The Oceanic Anoxic Event 2 (OAE 2) spanning the Cenomanian-Turonian boundary (~94 Ma) represents an interval of worldwide enhanced organic carbon burial in marine sediments, triggered by widespread O₂ deficiency in water column and/or an increased primary production in sea-surface. In epicontinental basins, anoxia establishment modalities are still debated and is probably due to complex interactions between global vs. local forcing factors.

In the Vocontian Basin (SE France), the OAE 2 is evidenced by a positive $\delta^{13}\text{C}$ excursion (+2.5‰) within the so-called “niveau Thomet”. This level is particularly well exposed at the Pont d’Issole section as a ~22m succession of calcareous dark shale (with TOC up to 2.5 wt.%), disrupted by bioturbated limestone intervals.

Iron speciation measurements ($\text{Fe}_{\text{HR}}/\text{Fe}_{\text{T}}$ and $\text{Fe}_{\text{py}}/\text{Fe}_{\text{HR}}$) indicate suboxic to euxinic conditions during the deposition of the organic-rich intervals and widespread oxic conditions associated with limestone intervals. Redox sensitive trace elements (e.g. Mo, V, U, Cr) also show strong oscillations with only small and brief enrichments in the shale intervals, suggesting sensible post-depositional reoxygenation within the OAE. A high degree of pyritisation linked to bacterial sulfate reduction is, however, recognized with high-amplitude negative excursion (~-40‰) in the $\delta^{34}\text{S}$ record starting with the OAE onset. Previous studies in different basins, including the Vocontian, supported the idea that OAE 2 was triggered by massive sulfate input, in a low-SO₄ Cretaceous ocean, associated with intensified volcanism and/or enhanced continental weathering. Fe-Mn-P coupled variations, negatively correlated to TOC and pyrite burial, indicate that bottom waters was dominated by Fe and Mn redox cycles in the Vocontian basin. P release from sediments to water column in anoxic environment may have contributed to fertilize the photic zone and enhance primary production maintaining anoxia during the OAE. Within the OAE 2 record, a major reoxygenation phase, previously pointed out in European and Atlantic sites, is associated with a regional atmospheric pCO₂ drawdown highlighted by a $\Delta^{13}\text{C}$ ($\delta^{13}\text{C}_{\text{org}} - \delta^{13}\text{C}_{\text{carb}}$) decrease. This, resulting in an episode of regional cooling known as the Plenus Cold Event, is suggested to bring oxygenated cold waters from boreal realms.