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Secular change in northwestern Tethyan water-mass oxygenation during the late Hauterivian – early Aptian: Insight from Ce anomalies in the Vocontian Basin

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The Mesozoic is punctuated by several extreme episodes of oxygen drawdown in the ocean, known as Oceanic Anoxic Events (OAE). Beside these discrete events, little is however known about longer-term oxygen level fluctuations and their controls. A high-resolution dataset of Rare Earth Elements content in carbonate deposited in the Vocontian Basin (SE France) has allowed to survey the evolution of the Cerium anomaly during the latest Hauterivian – early Aptian. This ratio is used as a proxy for the degree of oxygenation in the upper ocean layer. The Cerium anomaly is compared to the coeval evolution of relative sea level, organic-rich rock occurrences, bottom-water anoxia tracers and nutrient level proxies, in order to infer a cause-and-consequence relationship between these parameters and the evolution in sea-water oxygenation. The long-term evolution of the Cerium anomaly shows that northwestern Tethyan water masses have evolved from less oxygenated during the latest Hauterivian – early Barremian interval to more oxygenated during the late Barremian – earliest Aptian time, before being strongly oxygen-depleted during the early Aptian OAE 1a time interval. This trend is correlated with both the long-term trend in nutrient levels, as well as with the frequency of organic-rich layers within the rock record. On a medium-term scale, tectono-eustatism seems to play a critical role in controlling the water column oxygenation. Two OAEs have been surveyed by this study. From the comparison of the Ce anomaly proxy with the redox-sensitive trace-metal record, it appears that the early Aptian OAE 1a is characterized by depleted oxygen conditions both within upper oceanic layers and the bottom water environment, whereas strong oxygen depletion was limited to the bottom water during the late Hauterivian Faraoni Event. This might arise from a fundamental difference in the genesis of both events that can be seen in the light of the expanded oxygen-minimum zone versus stagnant ocean model; the former better suiting the early Aptian OAE 1a, the latter the latest Hauterivian Faraoni Event.