

Occurrence of PZE and intensification of marine primary production during the Cretaceous OAE1b in the Vocontian Basin.

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In mid-Cretaceous formations, the laminated and organic-rich black shales, which have been thought to be deposited under oxygen-poor oceanic condition, were occasionally discovered. The environmental disturbance events that had formed such black shales are called 'Oceanic Anoxic Events (OAEs)' occurred by ocean water stratification and/or high productivity at sea surface. Previous studies on OAE 1b demonstrated that wide occurrence of anoxic waters was attributed to episodic expansion of the oxygen minimum zone (OMZ), which was presumably formed as a result of intensification of marine primary production. However, few insights for paleo-ecosystem such as primary production have been obtained. In the present study, we reconstructed paleo-ecosystem by multi-biomarker analysis with high resolution (lamina levels) in the Vocontian Basin during the OAE1b (the Paquier level).

In the Paquier level, variations in concentrations of terrestrial biomarker such as retene were nearly synchronous to those of marine algal biomarkers such as steroids and dinosteroids. These results indicate that the nutrient was transported from land to ocean. Moreover, biomarkers of methanogenic archaea such as 2,6,15,19-tetramethylcosane (TMI) and 2,6,10,15,19-pentamethylcosane (PMI) were even detected at massive marls in the Paquier level. Concentrations of these biomarkers were higher at clearly laminated shale layers. It shows dysoxic to anoxic condition at seafloor during the Paquier levels and increase in methanogenic archaea related to the intensification of anoxic condition. Furthermore, biomarker of green sulfur bacteria, chlorobactane, was identified. Green sulfur bacteria including Chlorobiaceae are known to photosynthesize at euphotic zone under euxinic (anoxic and sulfidic) condition, and therefore, detection of its biomarker clearly indicates occurrence of 'photic zone euxinia (PZE)' during deposition of the Paquier levels. This is first report for the PZE at the OAE1b. Concentrations of chlorobactane were higher at clearly laminated shale layers and ammonoids-rich beds. In addition, triaromatic dinosterane index (TDSI⁺), which is used as an indicator for contribution of dinoflagellate in total primary producers of the sea surface layer, were higher value at black shale layers with high concentration of chlorobactane. It suggests that the PZE was associated from variation in dinoflagellate production during deposition of the Paquier level.

Keywords: Oceanic Anoxic Events (OAEs), photic zone euxinia (PZE), biomarker, green sulfur bacteria, dinoflagellate, supply of terrigenous material