# Response of primary producers in the ocean anoxic events during the Cretaceous

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In the Cretaceous, it is known that the “Ocean Anoxic Events (OAEs)” occurred repeatedly. In the OAEs, marine biogeochemical cycles, biological activity, and process of sedimentation may have been different from those under the oxic condition like today. In fact, biomarkers of cyanobacteria and green sulfur bacteria have been found from the sediments during the OAEs. It is therefore suggested that the redox condition and the primary procedures were quite different at the time of the OAEs. If we regard OAE as a disturbance to the marine biogeochemical cycle system, it is important to understand the response of photosynthetic ecosystem that plays a key role in controlling the ocean redox condition during OAEs.

In the Cretaceous, the climate was warmer and the sea level were higher than today because seafloor spreading rate were very high, hence the shallow water area expanded due to the transgression. Under such conditions, the ocean tends to be oligotrophic and oxic because vast shelf area is locus for the deposition of organic matters and traps large amounts of phosphate and nitrogen (Ozaki et al, 2013). We, however, do not know the marine biogeochemical cycles of nutrients and the behaviors of primary procedures under such a condition in the Cretaceous. We therefore developed a marine biogeochemical cycle model coupled with a marine ecosystem model and investigated the condition of OAEs ,marine biogeochemical cycles of nutrients and the behaviors of primary producers in the Cretaceous.

We found that algae is the dominant primary procedure under the “normal” Cretaceous condition, but once the global surface temperature rises owing to, such as activities of large igneous provinces (LIPs), concentration of phosphate in the ocean increases owing to enhanced chemical weathering of land surface. This leads to increase in the marine primary production which, in turn, promotes anoxic conditions in the ocean because dissolved oxygen is consumed by organic matter decomposition, initiating OAE. In the anoxic ocean, nitrogen is limited because nitrate is consumed by organic matter decomposition and thiodenitrification, inhibiting photosynthetic activity of algae. Cyanobacteria becomes dominant primary procedure because some of them can fix nitrogen. In the upwelling regions, green sulfur bacteria becomes dominant because hydrogen sulfide produced by sulfate reducing bacteria upwells to the euphotic zone.

Keywords: ocean anoxic events, Cretaceous, biomarkers, marine biogeochemical cycle modeling, green sulfur bacteria, cyanobacteria

 