Behaviors of marine primary producers during ocean anoxic events

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At the Ocean Anoxic Events (OAEs) during the Phanerozoic, biomarkers of cyanobacteria and green sulfur bacteria have been found, which suggests depletion of nitrogen and euxinic water condition in the euphotic zone (so-called "euphotic euxinia"), respectively. However, conditions to cause the depletion of nitrogen and the euphotic euxinia have not been known yet. We do not know well the behaviors of primary producers in the surface ocean when the ocean becomes anoxic. Here we investigated marine biogeochemical cycles of C, P, N, and S to understand these conditions and behaviors of primary producers quantitatively with a surface ocean biogeochemical cycle model. The results showed that nitrogen tends to deplete in the euphotic zone owing to net denitrification when the climate is much warmer than it is today. Under such conditions, cyanobacteria become dominant as a primary producer. When the upwelling rate is high in addition to the warmer climate condition, euxinic water upwells to the euphotic zone, hence green sulfur bacteria becomes dominant as a primary producer. We also found conditions for coexistence of eukaryotic algae, cyanobacteria, and green sulfur bacteria together within the euphotic zone, which could have been caused at coastal upwelling areas during the OAEs in the past.

Keywords: Ocean anoxic events, euphotic euxinia, biomarkers, marine biogeochemical cycle modeling