

Evaluation of 'paleo' red-tide during the mid-Cretaceous Oceanic Anoxic Event (OAE) 2.

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Red-tide is known as blooming of marine phytoplankton, especially dinoflagellate, under eutrophication, and severely influence on aquatic resources as natural toxins, harmful effects, and depletion of dissolved oxygen. Moreover, evidence for 'paleo' red-tide in the warming period can give understands for occurrence of red-tide associated with global warming in future.

Dinoflagellate *Apectodinium* increased during the Paleocene/Eocene Thermal Maximum (PETM) characterized by global warming (Slujis et al., 2007). However, micropaleontological investigation of dinocyst demonstrated that productivity of dinoflagellate presumably decreased as a result of the warming during the mid-Cretaceous Oceanic Anoxic Event (OAE) 2 (Pearce et al., 2009). Paleothermometer such as TEX₈₆ indicate the OAE2 include twice warming and once cooling phases (Forster et al., 2007), and detailed carbon isotope stratigraphy in that interval could enable to comparison between different localities. In this study, we focus on dinoflagellate biomarker (triaromatic dinosteroid) and very small dinoflagellate-like acritarchs, and compare these trends between the Yezo Group (YG; Hokkaido, Japan) and Vocontian Basin (VB; SE France) sediments. Values of dinoflagellate production proxy (triaromatic dinosteroid index; TADS) increase at twice during the OAE2 interval, the onset of 1st build-up phase and from the Trough to 2nd build-up phases, in both YG and VB sediments. These results are synchronous with global warming trend estimated by TEX₈₆ and suggest elevated contribution of dinoflagellate for primary production in different two sections located at NW Pacific and Tethys. Huber et al. (1999) reported 'collapse' of vertical stratification during the warming phase of the OAE2. These changes related to global warming presumably caused enhanced nutrient supply from intermediate and bottom water masses and global expansion of suitable condition for dinoflagellate. Moreover, marine palynomorphs are mainly composed of very small (< 20µm diameter) spiny acritarchs (*Micrhystridium*) in the higher TADS samples in both two sections. It was reported that *Micrhystridium*-accumulated fraction of the Cambrian sediments have high concentration of dinosteane (Talyzina et al., 2000), although the origin of these acritarchs are uncertain. These acritarchs are similar to Gonyaulacoid dinocyst in the morphology and smaller than these cysts, which suggest original species of these acritarch are autotrophic and r strategist such as modern red-tide species. From these results, it is implied that frequent occurrences of red-tides by small dinoflagellate were triggered by global warming and eutrophication, and promoted efficient deposition of organic matter and consequently expansion of anoxic water mass.

Keywords: Cretaceous, Dinoflagellate, red-tide, Oceanic Anoxic Events, acritarch