

Response of terrestrial climate to Cretaceous OAE2 observed in a sequence of Canadian Pacific coast

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Abstract

Across the Cretaceous Cenomanian / Turonian (C/T) boundary interval, a short-term event characterized by sediments rich in organic matter dominated over extended area of various oceanic setting around the world. This pronounced oceanic event is called Oceanic Anoxic Event 2 (OAE2). Considerable disturbance of global surface carbon circulation has been suggested during the event. Across the OAE2 interval, carbon isotope ratios of sedimentary organic carbon and carbonates show unique positive excursions, which are identified throughout the world. On the other hand, influence on the terrestrial environment during the event associated with the carbon cycle disturbance has been less discussed.

To understand the possible terrestrial climatic response related to this carbon cycle perturbation, Haida Gwaii, Pacific coast of western Canada, was studied. Limited macrofossils and carbon isotope stratigraphy well indicate the OAE2 interval through the section. Concentration of polycyclic aromatic hydrocarbons (PAHs) through continuous sequence in Haida Gwaii was evaluated as proxies for the terrestrial environment in the period of OAE2. Likely origin of PAHs in the sedimentary rocks is wildfire; terrestrial vegetation and/or soils can be the source. On the other hand, they can potentially be generated from thermal maturation. In the studied section, gradual increase of PAHs (pyrene, benzo(e)pyrene, benzo(a)pyrene, benzo(b)fluoranthene and benzo(ghi)perylene) content was observed within the OAE2 interval. Based on comparison of this increasing pattern with other thermal maturation indices (MPI-1, CPI), wildfire is concluded as the main origin of the PAHs. Increase of PAHs associated with OAE2 suggests the climate of the North American Pacific coast gradually turned into condition that is prone to induce frequent wildfire during the period of OAE2.

Haida Gwaii, presumably located around 35°N during the period of OAE2 (Ward et al., 1997) was dominated by the prevailing westerlies (Upchurch et al., 1999) whereas the latitude is seasonally controlled by subtropical high pressure belt (SHPB) at present. Hasegawa et al. (2013) suggested expansion-shrinkage oscillation of Hadley Cell associated with global climate during Cretaceous. Haida Gwaii located near the northern edge of SHPB could be a region sensitive to such Hadley Cell oscillation. Our observation of PAHs from the studied section could provide important information for discussion on Hadley Cell expansion under declining trend of climate associated with OAE2.

Reference

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