Response to Cretaceous Cenomanian/Turonian OAE2 in southern high latitude, Pacific

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At the Cretaceous Cenomanian/Turonian (C/T) boundary, a short-term event is known where sediment rich in organic matter is deposited in an extended oceanic area. This event is called Oceanic Anoxic Event 2 (OAE2) and considered to be one of the strongest and best studied perturbations of the carbon cycle during the Phanerozoic. Carbon isotope ratios of sedimentary organic carbon and carbonates show a unique positive excursion (CIE) through OAE2, which is identified throughout the world. Most studies on OAE2 have been undertaken for the Atlantic Ocean, the Tethys Sea and epicontinental seas of Europe and North America. Although the Pacific Ocean was the largest ocean on the Earth during the Cretaceous period, little is known about its response associated with OAE2. To understand the influence of surface carbon cycle disturbances on ocean and terrestrial realms in southern high latitude Pacific, a comprehensive organic geochemical study on samples extracted from outcrops comprising C/T boundary segments was carried out. These outcrops are situated near Blenheim in Marlborough, South Island, New Zealand. The homohopane Index (HHI) obtained from biomarker analysis produced remarkable data that were not identified from OAE2 intervals elsewhere before– i.e., the periodic fluctuation of suboxic (anoxic) and oxic environments at the sea floor. The correlative interval of the earliest phase of OAE2 shows strong oxygen depletion, followed by a rapid and prominent shift from anoxic to oxic conditions. A dramatic decrease in the sterane/hopane (S/H) ratio is found ~100 kyr following the HHI drop, and therefore nearly in conjunction with it. This diminished and/or reduced ratio in eukaryote-derived biomarkers is an indication of decreased transportation of marine organic matter to the ocean floor and therefore of diminished marine productivity. This palaeo-ecological change through the water column might lead to oxic instead of anoxic sea bottom conditions during the OAE2 interval. As it cannot explain the oxic bottom conditions preceding the phase of diminished productivity, bottom water oxygenation with exotic cold water inflow is more likely to explain these marine biomarker fluctuations through the OAE2 interval. Relative concentration of terrestrial PAHs across the OAE2 interval indicates high-latitude southern Pacific climate to have gradually turned into a condition with frequent wildfire just before the OAE2 interval. Thereafter, wildfire frequency dramatically decreased coincident with the onset of the CIE and remained low through the OAE2 interval and increased following OAE2. From biomarkers related to oceanic and terrestrial environments, both ocean and terrestrial realms in southern high latitude Pacific appear to have significantly changed during the OAE2 interval. The environmental change in this region during OAE2 was very different from the Tethys Ocean and other sites, indicating that the mechanisms involved in the triggering and evolution of the OAE2 were more complex than thought before.