BPT26-P01 Room:Poster Time:May 2 16:15-17:30

Conditions for photic zone euxinia deduced from ocean biogeochemical cycle model

OIDE, Kana[1*] ; OZAKI, Kazumi[2] ; TAJIKA, Eiichi[1]

[1]University of Tokyo, [2]Atmosphere and Ocean Research Institute, University of Tokyo

It is widely thought that atmospheric oxygen concentration has been kept in a level of the same order of magnitude as that of today over the Phanerozoic, based on both charcoal records and geochemical cycle modeling.

On the other hand, several lines of geological/geochemical evidence indicate that the oceans below photic zone were strongly de-oxygenated on a global scale at some geological intervals. Such oxygen deficient events are known as "Oceanic Anoxic Events (OAEs)."

In the anoxic water column, hydrogen sulfide is produced via bacterial sulfate reduction. Therefore, if sulfate and metabolizable organic matter are sufficient, hydrogen sulfide builds up in some cases, which is called "ocean euxinia."

Biomarkers derived from photosynthetic green sulfur bacteria have been discovered in the sedimentary rocks deposited during the Mesozoic OAEs(e.g., early-Triassic superanoxia and Cretaceous OAE2) indicating that hydrogen sulfide existed in the photic zone (~100m) at those intervals. However, the conditions required to generate the photic zone euxinia remains unrevealed.

Here we investigate the conditions required for occurrence of photic zone euxinia, using an ocean biogeochemical cycle model developed by Ozaki and Tajika (2013). We further improve the model to have the surface ocean with higher resolution to evaluate the vertical profiles of H_2S, NO_3, HPO_4, and O_2, We try to understand the changes of marine primary producer during photic zone euxinia quantitatively.

Keywords: oceanic anoxic events, biogeochemical cycles, phosphorus cycle, anoxia/euxinia, photic zone euxinia

Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

BPT26-P02 Room:Poster Time:May 2 16:15-17:30

Partial pressure of atmospheric CO2 during the Paleoproterozoic global glaciation

SHIBUYA, Takazo[1*] ; UENO, Yuichiro[2] ; KOMIYA, Tsuyoshi[3] ; NISHIZAWA, Manabu[1] ; KITAJIMA, Kouki[4] ; YAMAMOTO, Shinji[3] ; SAITOU, Takuya[2] ; TAKAI, Ken[1] ; YOSHIDA, Naohiro[2] ; MARUYAMA, Shigenori[2] ; RUSSELL, Michael[5]

[1]JAMSTEC, [2]Tokyo Institute of Technology, [3]University of Tokyo, [4]University of Wisconsin, [5]Jet Propulsion Laboratory

The Paleoproterozoic Makganyene Glaciation is a particular enigmatic geologic event in that ice covered the oceans even at low latitude (Snowball Earth). This event might have drastically curtailed biological productivity but melting of the oceanic ice presumably induced a cyanobacterial bloom, leading to an acceleration of global oxygenation. It has been predicted that this event occurred as a result of the drawdown of greenhouse gases in the atmosphere. However, atmospheric CO2 levels at that time are still under debate. Here, we constrained the CO2 concentration in seawater based on fluid inclusions in subseafloor hydrothermal quartz deposits from the 2.2 billion years (Gyr) old Ongeluk volcanics, South Africa, in which the ancient water and carbon dioxide are preserved. The quantitative analysis of the concentration and stable carbon isotopes of CO2 in the fluid inclusions revealed that the CO2 concentration in the seawater was limited to be less than 7 mmol/kg. Because the Ongeluk seawater was locally open to the atmosphere, atmospheric CO2 level was also estimated to be lower than 33 times the present atmospheric level (PAL) ($<1.3\times10$?2 bar) assuming equilibrium between the Ongeluk seawater and atmosphere. This CO2 level was not enough to compensate the faint young sun and keep the ocean temperature sufficiently above freezing point by itself. Although the behavior of other greenhouse gases is still unknown, our results demonstrate that the deficient atmospheric CO2 level was a significant contributing factor to the 2.2 Gyr global glaciation.