Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

BPT26-04 Room:104 Time:May 26 17:00-17:15

Nitrogen isotope chemostratigraphy from the Ediacaran to early Cambrian in South China

KOMIYA, Tsuyoshi[1*] ; NISHIZAWA, Manabu[2] ; TSUCHIYA, Yuki[1]

[1]Department of Astronomy & Earth Sciences, The University of Tokyo, Komaba, [2]Japan Agency for Marine-Earth Science and Technology

The earth is only the planet where higher forms of life exist. The appearance and evolution of metazoans are the most important issue of the evolution of the earth and life, but the causes are still obscure. It is considered that increase in oxygen content of atmosphere and seawater resulted in the evolution, but the evidence for correlation between the increase in the oxygen content and biological evolution is poor. This study focuses on nitrogen that is one of the most important nutrients at present. Preservation of continuous and fossiliferous strata from the Ediacaran to the Cambrian, South China is suitable for reconstruction of secular change of compositions of seawater through the time. This study presents secular change of nitrogen cycle from the Ediacaran to the Early Cambrian including shallow marine and deep-sea environments based on chemostratigraphies of organic nitrogen isotopes of shallow marine and deep-sea environments.

We obtained the nitrogen isotope ratios of organic nitrogen in black shales and carbonate rocks of drill core samples from the Shuijingtuo and Shipai Formations. The nitrogen isotope ratios gradually increase from -1 to +3 permil in Shuijingtuo Formation whereas they are fluctuated between +2 and +4 permil in Shipai Formation. In addition, the variation of the nitrogen isotope ratios is not related with difference of lithology: carbonate rocks and black shale, respectively. In addition, no correlations between the nitrogen isotope ratios and C/N ratios or total N contents are found. The results indicate that the variation in the nitrogen isotope values is not artificial due to lithological change and secondary alteration but it was caused by environmental change in the Early Cambrian. The nitrogen isotope ratios gradually increase in the black shale of the upper Shuijingtuo Formation, suggesting decrease of the nitrate content of the seawater. In other words, it shows that the nitrate-rich environment was terminated and both nitrate and phosphate started to be limited since the beginning of the Botomian, namely mid-Cambrian Series2 possibly due to increasing primary productivity. Namely, modern-style marine nutrient cycle was established in the early Cambrian. The higher primary productivity led to increase of the oxygen content of the atmosphere and ocean, promoting the Cambrian explosion.

Carbon isotope chemostratigraphy is often used for comparison among sections because of lack of key fossils in the Ediacaran. However, it is well known that carbon isotope ratios of organic carbon were decoupled with those of carbonate carbon in the Ediacaran. In addition, the inorganic carbon isotope chemostratigraphies are highly distinct between shallow marine and deep-sea environments in the Ediacaran. They make it impossible to compare shallow water environments with and deep-sea environments based on the carbon isotope chemostratigraphies. In order to establish a new tool for the comparison, we analyzed nitrogen and carbon isotope ratios of organic matter of Yuanling section, deposited in a deep-sea environment, in South China from Ediacaran to early Cambrian. The results show that the pattern of nitrogen isotope chemostratigraphy in Yuanling section is similar to that in the Three Gorges area, platform sediments, from the Ediacaran to the Early Cambrian, indicating the nitrogen isotope is useful to compare between the shallow marine and deep-sea sediments. The nitrogen isotope ratios of the deep-sea sediments in the Ediacaran are lower than those of the shallow marine sediments. The difference may be because pelagic environment was more enriched in nitrate than platform environments in photic zone.

Keywords: Ediacaran, Cambrian explosion, Nitrogen isotopes, Nutrients, Biological evolution, History of the earth