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

BPT23-04 Room:411 Time:April 30 09:45-10:00

Nitrogen isotope chemostratigraphy of the Early Cambrian platform sequence at Three Gorges, South China

TSUCHIYA, Yuki[1*] ; TAHATA, Miyuki[2] ; NISHIZAWA, Manabu[3] ; SAWAKI, Yusuke[2] ; SATO, Tomohiko[2] ; KOMIYA, Tsuyoshi[1]

[1]Department of Earth and Planetary Science, The University of Tokyo, [2]Department of Earth and Planetary Science, Tokyo institute of technology, [3]Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

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. We made multi-isotope and elemental chemostratigraphies of drill core samples from the Ediacaran to Cambrian in South China. The results show that secular changes of nutrients influenced the evolution of the metazoan. We focused nitrogen that is one of the most important nutrients in bioessential elements, and reconstructed the temporal variation of the oceanic nitrate contents in the early Cambrian.Preservation of continuous and fossiliferous strata from the Ediacaran to the Cambrian, South China provides reconstruction of secular change of compositions of seawater through the time.

Kikumoto et al.(2014) analyzed the nitrogen isotope ratios of the organic nitrogen. The results show that the nitrogen isotope ratios were high from early to middle Ediacaran, and decreased from middle Ediacaran to earliest Cambrian and then became high. They interpreted the change in the nitrogen isotope as secular change of nitrate contents of seawater through the time. And Shimura et al.(2014) showed phosphorus contents in carbonate rocks and minerals from the Ediacaran to the Cambrian, and estimated secular change of phosphorus contents of seawater through the time. As a result, they interpreted that the seawater was depleted in nitrate contents from the early to the middle Ediacaran due to high phosphorus contents. From the middle Ediacaran to the earliest Cambrian, the seawater had higher nitrate contents because of decrease of phosphorus contents possibly due to oxidation of seawater and then lower nitrate contents after the early Middle Cambrian.

The hypothesis is very attractive, but many problems remain, especially in the Cambrian samples. One is whether the change in the nitrogen isotope values is controlled by lithological change. The second is which the change was transient or abrupt because the previous work showed no nitrogen isotope variation between them. Correlation of the nitrogen isotope values with other proxies was unclear, too. This work presents the nitrogen isotope ratios of organic nitrogen in black shales and carbonate rocks of drill core samples from the Shuijintuo and Shipai formations.The nitrogen isotope ratios gradually increase from +2 to -2 ‰ in the Shuijingtuo Formation, whereas they are fluctuated from ca. +1 to +3 ‰ in the Shipai Formation. In addition, the variation of the nitrogen isotope ratios is not related with difference of lithology: carbonate rocks and black shales, respectively. Although low nitrogen isotope anomalies are found in samples with low organic nitrogen contents, no clear correlation between the total organic nitrogen contents and nitrogen isotope ratios is observed. 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 through the Early Cambrian. The increase of the nitrogen isotope ratios was gradual, and was found in the black shales at the upper part of the Shuijingtuo Formation, indicating that the change was transient. There is no correlation between the nitrogen and carbon isotope values of organic matter through the time.

The increase of the nitrogen isotope ratios indicates that the nitrate content of the surface seawater decreased. In other words, it shows that the nitrate-rich environment was completed in the early Cambrian and that nitrate started to be limited with increasing primary production and denitrification activity became significant. It shows that the modern-style marine nitrogen cycle was established in the early Cambrian. Higher primary productivity led to increase of the oxygen content of the atmosphere and ocean, promoting the Cambrian explosion.