Nitrogen isotope chemostratigraphies of the shallow- and deep-sea strata from the Ediacaran to early Cambrian in South China: Evolution of marine nutrient system and animal evolution

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The Ediacaran to the Early Cambrian periods are one of the most drastic ages because of the first appearance and rapid diversification of metazoans and ocean oxygenation. The profound environmental and biological evolution must have been linked, but the underlying mechanism is still unclear. This study reports chemostratigraphies of nitrogen and carbon isotopes, and C/N ratios of the shallow shelf and deep basin sections in the Yangtze platform, South China to unravel the spatiotemporal trends of biogeochemical cycles and their relationships with dynamics of dissolved and suspended organic matter (DOM/SOM) reservoir in the Ediacaran and Early Cambrian oceans. The chemostratigraphies of the C/N ratios and nitrogen isotopes in the shallow shelf and deep basin environments are similar to each other, which provides a new tool to compare between the fossiliferous shallow shelf and fossil-free deep basin sections, and suggests that similar temporal changes occurred both in the environments. The Three Gorges section deposited in the shallow shelf environment can be subdivided into ten intervals based on the C/N ratios: 4 positive, 3 negative and 4 transitional intervals. The negative intervals, characterized by quite low C/N ratios, correspond to negative $\delta^{13}C_{carb}$ excursions, when massive remineralization of the DOM/SOM reservoir occurred. Thus, the low C/N ratios likely originate from the preferential input of ammonium in seawater origin. The $\delta^{15}N$ chemostratigraphy at the shallow shelf and deep basin sections shares a similar trend, which shows that the $\delta^{15}N$ values decrease from the Shuram excursion to around the Terreneuvian–Cambrian Series 2 boundary and then increase continuously. In the contexts of paleontology and geochemistry in those periods, the $\delta^{15}N$ change is best attributed to the temporal change in nitrate and/or ammonium content in the euphotic zone that is possibly caused by the rise of effective phosphorus uptake strategy for primary producers such as eukaryotic phytoplankton. We suggest that the Phanerozoic-type nutrient system, which the surface water is basically depleted in both nitrogen and phosphorous, started to control the marine oxygen content, and caused mass extinction and subsequent diversification of metazoans since the Terreneuvian–Cambrian Series 2 boundary.

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