Nitrogen/Carbon isotope ratios of middle Proterozoic sedimentary rocks, McArthur Basin, Northern Australia

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It has generally been assumed that the middle Proterozoic ocean was globally oxic at the surface, anoxic (euxinic or ferruginous) in the deep ocean[1,2]. Previous studies of nitrogen isotope ratios in the middle Proterozoic ocean have focused on water depth and nitrogen cycle, insisting on nitrate minimum with the lowest concentrations in offshore environments[3,4]. In this study, we focused on the relationship between redox conditions and nitrogen cycle through the analysis of nitrogen and carbon isotope compositions of middle Proterozoic sedimentary rocks from the McArthur Basin in Northern Australia.

The average $\delta^{15}N_{TN}$ value of oxic and anoxic sediments is 2.52 and 2.65‰ respectively, suggesting the occurrences of water column denitrification regardless of redox conditions. It means that the isotopic signature of the aerobic nitrogen cycle is seen in shallow photic zone even in offshore environments.

In addition, the difference in distribution pattern of C/N atomic ratios related to redox conditions was observed in the Roper Group. In oxic conditions, C/N atomic ratios of samples were lower than 20, whereas those in anoxic conditions were from 2.66 to 68.89 which can be separated into two parts: lower than 35 (anoxic I) and higher than 35 (anoxic II). Compared with C/N ratios and depositional depth, we found that the deeper deposits have higher C/N ratios than shallower deposits, suggesting depositional depth of anoxic II is deeper than that of anoxic I. The C/N ratios of sedimentary rock are ordinarily used for selective removal of nitrogen during diagenesis, whereas the elevated TOC/TN ratio in the Roper Group might be explained by the accumulation of N-depleted bio-molecules. The distribution pattern of microfossils record[5] and biomaker studies[6,7] in the Roper strata are consistent with our speculation of habitat segregation of eukaryotic algae and cyanobacteria.

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