Perturbations of the nitrogen cycle in mid-Panthalassa in the Late Guadalupian (Middle Permian)

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To examine the changes in the oceanic N cycle and their possible relationships to the extinction at the end-Guadalupian (Middle Permian), we analyzed the N isotopic compositions (Δ15N) of the upper Guadalupian paleo-atoll limestone, accumulated on the top of a mid-oceanic seamount in the superocean Panthalassa, at Akasaka in central Japan. The Δ15N values of the limestone are substantially high (ca. +20 permil on average) throughout the analyzed interval. These values are the highest in the previously reported Δ15N records throughout the entire Phanerozoic. The substantially high Δ15N values suggest enhanced oceanic denitrification/anammox in the Capitanian (Late Guadalupian). Moreover, the present results revealed remarkably large Δ15N fluctuations in the analyzed limestone at Akasaka. We interpret that periodic expansion and reduction of the oxygen minimum zone (OMZ) in mid-Panthalassa caused the observed Δ15N fluctuations in the Capitanian. The suggested OMZ expansions may have been attributed to the high productivity 'Kamura event' in the surface oceans enhancing a biological pump. Chemostratigraphic correlations imply that the enhanced denitrification in the expanded OMZ may have been a global phenomenon in the Capitanian. Widespread developments of the anoxic deep-waters prior to the extinction may have stressed the shallow-marine biota by upwelling at the end-Guadalupian.