

Sulfur and carbon isotope study for understanding environmental changes across the Middle/Late Permian boundary

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The mass extinction at the end of the Paleozoic Era has been recognized as the most severe extinction event in the history of life. Such severe diversity loss could be attributed to the combined consequences of two successive mass extinctions, which occurred at the Guadalupian-Lopingian (G-L) (Middle-Late Permian) boundary (260 Ma) and the Permian-Triassic (P-T) boundary (250 Ma). Drastic environmental change during this time likely started immediately before the G-L boundary and reached a maximum around the P-T boundary. In order to understand paleoenvironmental change in oceans across the G-L boundary, we analyzed secular changes in sulfur and carbon isotope ratios of Middle-Upper Permian carbonates of an accreted mid-oceanic paleoatoll complex at Kamura in central Kyushu, Japan.

Negative correlations were observed between $\delta^{34}\text{S}_{CAS}$ and $\delta^{13}\text{C}_{carbonate}$ values for Guadalupian and Lopingian carbonates, respectively. These correlations imply that the bottom water anoxia expanded to the open oceans before and after the G-L boundary. In such environments, organic matter was oxidized by sulfate-reducing bacteria in the water column, which produced negative $\delta^{34}\text{S}_{CAS}$ - $\delta^{13}\text{C}_{carbonate}$ correlations.

The slopes of the negative correlations varied at the G-L boundary. This implies that the supply processes of carbon and sulfur into the oceans changed at the boundary. This finding suggests that the magmatic chemistry changed at the boundary from sulfur-rich type to CO_2 -rich type.

Keywords: Guadalupian-Lopingian boundary, mass extinction, oceanic anoxia, carbonate-associated sulfate, Panthalassan paleoatoll carbonates