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High-resolution litho- and chemo- stratigraphy across the Middle-Late Permian boundary in the mid-oceanic limestone

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The extinction around the Guadalupian-Lopingian boundary (G-LB) recorded the first major biodiversity drop during the Permian. In order to clarify the relevant global environmental changes immediately before the G-LB, high-resolution chemostratigraphy of $^{87}Sr/^{86}Sr$ and $d^{13}C_{carb}$ was analyzed for the Middle Permian paleo-atoll limestone at Akasaka and Ishiyama in central Japan.

Both limestones were derived from a paleo-atoll complex deposited primarily in the low latitude a mid-Panthalassa. At both sections, the Middle Permian black limestone is overlain by the Upper Permian light gray limestone. An interval of white-black striped limestone occurs between the two, and its top marks the G-LB horizon. Fusuline biostratigraphy indicates that the black limestone belongs to the Yabeina Zone (Capitanian; late Guadalupian), whereas the light gray limestone to the Codonofusiella-Reichelina Zone (Wuchiapingian; early Lopingian). The ”barren interval” between them is divided into the lower 1) black limestone, and the upper 2) striped limestone without smaller foraminifer and gastropod.

The lithofacies of the black limestone and of the striped limestone indicates that the depositional setting was subtidal zone and intertidal zone, respectively.

At the Akasaka Limestone, a very thin ($<$5 mm-thick) light greenish non-carbonate layer occurs between the striped limestone and the light gray limestone, which was once reported as a felsic tuff. This layer is enriched in elements such as Al, Fe, K and Cr. The source was not yet identified, however, this layer is possibly correlated with the Wangpo Bed, i.e., the G-LB marker in South China.

This study confirms that $^{87}Sr/^{86}Sr$ ratios stayed extremely low around 0.7068 throughout the Capitanian and increased rapidly to 0.7074 at the G-LB, and that the ”Permian minimium” has persisted throughout the entire Capitanian for more than 5 million years. The $d^{13}C_{carb}$ values stayed extremely high, +6 permil, throughout the Capitanian, and dropped to +2 permil at the G-LB. This records, no doubt, the Capitanian Kamura event of the very high primary productivity of surface ocean. These isotope profiles are correlated well with those of the coeval Iwato Formation in Kyushu, thus likely reflecting the general trend of the low latitude mid-superocean seawater.

The change in lithofacies towards the G-LB recorded that the depositional setting reached the shallowest during the deposition of striped limestone. This implies that sea level became shallower towards the G-L boundary. In accordance with the lowest sea level around the G-L boundary, this may suggest that global cooling has appeared immediately before the G-L boundary and possibly caused the end-Capitanian extinction.

Keywords: G-L boundary, Akasaka Limestone, Ishiyama Limestone, carbon isotope, strontium isotope