論文の内容の要旨

論文題目

The end-Guadalupian (Permian) mass extinction and relevant environmental changes in the superocean Panthalassa: litho-, bio-, and chemostratigraphy of accreted paleo-atoll limestones in Japan

（超海洋パンサラサにおけるガダルピアン世（ペルム紀）末の大量絶滅と環境変動：日本に付加した古礁石灰岩の岩相・生・化学層序）

氏　名　　小福田　大輔

The biggest mass extinction of the Phanerozoic occurred at the end of the Paleozoic, ca. 252 million years ago (Ma); in fact in two steps, i.e. first at the boundary between the Guadalupian (Middle Permian) and Lopingian (Late Permian) (ca. 260 Ma), and second at the boundary between the Permian and the Triassic (ca. 252 Ma). The Guadalupian-Lopingian boundary (G-LB) event is more significant than that of the Permian-Triassic boundary, because this event marked the first large decline of the long-lasting Paleozoic fauna. Despite over 100 year-long previous studies about the end-Paleozoic extinction event, the main cause of the extinction has not yet been identified. This study analyzed litho-, bio-, and chemostratigraphy of the Middle-Upper Permian limestone in Japan, in order to identify the nature of extinction-related environmental changes.

The Capitanian (upper Guadalupian) to Wuchiapingian (lower Lopingian) shallow-marine limestones at Akasaka and Ishiyama in central Japan record unique aspects of the extinction-related G-LB interval, because they preserve extremely rare environmental records of mid-superocean. The ca. 140 m-thick Akasaka Limestone consists of the Capitanian black bioclastic limestone (Unit B; 112 m) and the overlying

Wuchiapingian light gray dolomitic limestone (Unit W; 21 m), with a black/white striped limestone (Unit S; 9 m) between them. The G-LB horizon is assigned at the base of Unit W, on the basis of the first occurrence of the Wuchiapingian fusulines.

The Capitanian Unit B and the Wuchiapingian Unit W were deposited mostly in the subtidal zone in a lagoon setting of an atoll, whereas the intervened Unit S and the lowermost Unit W were in the intertidal zone. A hiatus with a remarkable erosional feature was newly identified at the top of Unit S. This indicates that the sea-level dropped significantly around the G-LB to have exposed the top of the atoll complex above the sea-level. Almost the same depositional record was confirmed in the Ishiyama Limestone located ca. 10 km to the north of Akasaka.

The extinction of large-tested fusuline (*Yabeina*) and large bivalves (Alatoconchidae) occurred in the upper part of Unit B, and the overlying 20 m-thick limestone (the uppermost Unit B and Unit S) below the hiatus represents a unique barren interval. The upper half of the barren interval is more depleted in fossils than the lower half, and this likely represents a duration of the severest environmental stress(es) for the shallow-marine protists/animals on the mid-oceanic paleo-atoll complex. Small-tested fusulines re-appeared at the base of Unit W immediately above the hiatus. These facts prove that the elimination of shallow-marine biota occurred during the Capitanian shallowing of Akasaka paleo-atoll before the subaerial exposure/erosion across the G-LB. The overall shallowing and the development of a clear hiatus at the top of a mid-oceanic seamount indicates that a remarkable sea-level drop had occurred globally during the latest Capitanian in accordance with the contemporary sea-level curve based on continental shelf records. This further suggests that a cool climate likely has appeared even in the low-latitude domains in Panthalassa to cause the decline of the Middle Permian shallow-water protists/animals that were adapted to warmer seawaters. The Wuchiapingian biota first appeared immediately after this erosional episode, i.e., during the onset of warming after the G-LB.

In order to access the extinction-relevant changes in mid-oceanic surface seawater, this study analyzed carbon and strontium isotope ratios of bulk carbonate. As to inorganic carbon isotope ratio of seawater ($\delta^{13}C_{carb}$), very high value (> +5.0 ‰) was detected in the upper Capitanian, and dropped across the G-LB. This pattern suggests stable high-productivity by enhanced oceanic circulation in the Capitanian and following rapid drop across the G-LB. $^{87}Sr/^{86}Sr$ was extremely low (<0.7070) throughout the Capitanian and sharply rose up to 0.7073 across the G-LB, indicating the long-term suppression of continental flux into the superocean, and following increase. This pattern can be explained in terms of the expansion of continental glacier in the Capitanian and following shrink across the G-LB. These isotopic patterns are concordant with the Capitanian global cooling and following warming after the G-LB suggested by the litho- and biostratigraphy.

On the basis of these new results, I conclude that the end-Capitanian mass extinction event was caused likely by the global cooling during the late Guadalupian. The faunal recovery in the Late Permian apparently occurred during the global warming after the G-LB.