

The Toarcian Oceanic Anoxic Event and biodiversity fall of Jurassic ammonoid assemblage in the Toyora Group, Yamaguchi Prefecture

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The Toarcian Oceanic Anoxic Event (OAE) is characterized by the worldwide distribution of organic black shale, suggesting that this phenomenon was global. The black shale deposition is recorded not only in continental shelf sediments but pelagic successions. This event has been studied in detail in Europe from various viewpoints including sedimentology, paleontology, and geochemistry. Contributions from the Asian regions are still limited. The aims of this study are to analyze the diversity trend in ammonoid based on the value of diversity, origination and extinction, and to discuss the relationship between the diversity crises and the OAE in the Early Toarcian.

Paleontological analyses have been carried out mainly on the relationship between the OAE and the mass extinction events. Two mass-extinction events of ammonoids were recognized in both the NW European and the Mediterranean provinces around the Upper Pliensbachian-Lower Toarcian (seven ammonoid zones, about 4.7My). The first mass-extinction took place at the Pliensbachian/Toarcian boundary which is connected with the extinction of boreal ammonoids and sea-level fall, while the second mass-extinction took place at the uppermost part of the Semicelatum Subzone of the European zonation. It corresponds to the beginning of the Early Toarcian OAE. This extinction is characterized by the diversity fall and the increasing value of extinction. In addition, the diversity of endemic species significantly fell at this horizon.

In Japan, the existence of the Toarcian OAE was discussed in the Nishinakayama Formation, the middle part of the Toyora Group (Lower to Middle Jurassic continental shelf sediment). This formation is mainly composed of black mudstone. The black mudstones in the middle part of the formation were considered to compare with the facies of the global OAE based on the evidence of fauna and sedimentary facies. This formation is also known as the major source of Late Pliensbachian-Early Toarcian ammonoid fossils. Ammonoid biostratigraphic work was carried out along the North Valley of the Sakuraguchi-dani Valley. The following four successive ammonoid zones were recognized in the Nishinakayama Formation in ascending order; the *Fontanelliceras fontanellense* Zone, *Protogrammoceras nipponicum* Zone, *Dactylioceras helianthoides* Zone, and *Harpoceras inouyei* Zone. The Pliensbachian/Toarcian boundary corresponds to the base of the *D. helianthoides* Zone.

The analysis of ammonoid diversity trend is done along the North Valley of the Sakuraguchi-dani Valley. The evolutionary trends of diversity, origination and extinction are discussed in species level and genus level. As a result, a diversity fall is recognized in the uppermost *D. helianthoides* Zone (Lower Toarcian). This event is characterized by the minor decrease of diversity and no major value of extinction. It is characterized by the diversity fall of *Harpoceratinae* and that of endemic species. Moreover, the diversity fall corresponds to the lowermost *Exaratum* Subzone of the NW European zonation. Consequently, it is coeval with the second mass-extinction event which is related to the Toarcian OAE in Europe. The effect of the Toarcian OAE seems to have reached the coastal areas of East Asia.