

MIS025-01

Room:104

Time:May 24 08:30-08:45

Ammonoid faunal changes during late Early Jurassic (Late Pliensbachian-Toarcian) and Early Toarcian Oceanic Anoxic Event

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The time-interval of late Early Jurassic (Late Pliensbachian to Toarcian) has been characterized by some paleoceanographic events, especially represented by the Early Toarcian Oceanic Anoxic Event (OAE). The ammonoid faunas in the Northern Hemisphere were affected by these paleoenvironmental changes in this period. A dramatic diversity crisis of the ammonoid assemblages, biostratigraphically corresponded to the Exaratum Standard Subzone (middle Early Toarcian), was mainly recognized in the Submediterranean province including Apennines (central Italy), Subbetic (southern Spain) and High-Atlas (Morocco). This extinction event was considered to be caused by the coeval Early Toarcian OAE. The effects of this OAE have been also reported in North American Cordillera, North Tibet and pelagic areas (West Panthalassa and West Tethys). In contrast, a diversity fall at the Pliensbachian/Toarcian (P/T) boundary, which was characteristic in the extinction of Amaltheidae, the typical Boreal element in Late Pliensbachian, has been mainly distinguished in the Northwest European province, such as England, Paris Basin (northern France) and the Causses Basin (southern France). Moreover, an abrupt warming on the basis of the oxygen isotope fluctuation and the low stand of eustatic sea level analyzed by the Sr isotope ratio were also distinguishable around the P/T boundary through the Northwest European and the Mediterranean provinces.

In this study, a diversity fall of ammonoid assemblage from the Toyora Group is identified in the Paltarpites paltus Zone which is compared to the lower part of the Tenuicostatum Standard Zone, earliest Toarcian. This diversity crisis is characterized by the extinction of Harpoceratinae, and the survival of only a species of pandemic Arieticeratinae. Moreover, this event is stratigraphically corresponded to the anomalies of trace element concentrations (including V, Ni, Ba and Co), rare earth element (Ce) and carbon isotope fluctuation. Consequently, the ammonoid diversity crisis in the Paltarpites paltus Zone is perhaps reflected by the oxygen-deplete marine condition in East Asia, biostratigraphically earlier than the European Early Toarcian OAE. In contrast, some ammonoid bio-events during late Early Jurassic time are also recognizable in Japanese assemblages from the Toyora Group, the Early to Middle Jurassic epicontinental clastic sediments in southwest Japan, and the Kuruma Group, the Early Jurassic continental shelf deposits exposed in central Japan. A turnover from the Boreal fauna composed of Amaltheidae to the Tethyan fauna dominated by Arieticeratinae (Hildoceratidae) is distinguished mainly in the Kuruma Group during the Apyrenum Standard Subzone (latest Pliensbachian). This faunal change is chronologically discordant for the comparable faunal turnover in the almost equal paleolatitudinal areas of the Northwest European province, which is corresponded to the P/T boundary. The turnover recognized in the latest Pliensbachian ammonoid fauna from Japan seems to be mainly affected by the regression during latest Pliensbachian (Spinatum Standard Zone) to earliest Toarcian (Tenuicostatum Standard Zone), in addition to the starting of the warming event. The data of ammonoid faunal transition in East Asia enables to contribute to the discussion of global ammonoid paleobiogeography in late Early Jurassic time.

Keywords: late Early Jurassic, ammonoid, Early Toarcian Oceanic Anoxic Event (OAE), extinction, paleobiogeography

MIS025-02

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Toarcian (late Early Jurassic) oceanic anoxic event and ammonoid/radiolarian biostratigraphic framework worldwide

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The Early Toarcian oceanic anoxic event (OAE) is regarded as one of the most large-scale oceanographic changes through the Phanerozoic. This phenomenon has been analyzed in detail mainly in Europe from various viewpoints. It is essential to establish biostratigraphic frameworks applicable to both neritic and pelagic environments to clarify the exact timing and spatial extent of the event. Recent progress in ammonoid and radiolarian biostratigraphy encompassing the Toarcian interval is overviewed.

Upper Pliensbachian-Toarcian ammonoid stratigraphy in East Asia is recently revised based on a detailed biostratigraphic re-examination in the Toyora Group, Yamagichi Prefecture. Six ammonoid zones are proposed as follows, in ascending order: the *Amaltheus stokesi* Assemblage Zone, the *Canavaria japonica* Zone, the *Paltarpites paltus* Zone, the *Dactylioceras helianthoides* Zone, the *Harpoceras inouei* Zone, and the *Pseudogrammoceras-Phlyseogrammoceas* Assemblage Zone. The base of the *Paltarpites paltus* Zone corresponds to the base of the Toarcian.

Global radiolarian zonation for the Pliensbachian, Toarcian and Aalenian is proposed as a result of international collaboration (Carter et al., 2010). Nine zones are set up for this interval. The Early Toarcian zone (*Eucyrtidiellum nagaiae* - *Praeparvicingula tlellensis* Zone) is recognized in the Queen Charlotte Islands (Canada), Slovenia, Oman and Japan.

Our analysis on the Pliensbachian-Toarcian stratigraphy of the Toyora Group reveals that the Early Toarcian OAE is not distinctive in the neritic environment of the eastern margin of Asia. On the other hand, a remarkable faunal turnover of radiolarians related to the OAE has been pointed out in pelagic chert sequences in the Panthalassa (Hori, 1997). A precise timing and magnitude of the OAE in the Panthalassa can be clarified by using the newly established radiolarian zonal scheme.

Keywords: Mesozoic, Jurassic, Toarcian oceanic anoxic event, ammonoid, radiolaria, biostratigraphy

MIS025-03

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Detailed examination on upper Triassic radiolarian biostratigraphy in the Sakahogi section of the Mino Terrane, Japan

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The Sakahogi section, exposed along the Kiso River, has continuous Panthalassa sedimentation records in the Triassic (Nikaido and Matsuoka, 2007). The interval is litho-stratigraphically divided into three (lower, middle and upper) parts. Three claystone layers that named CS-1, 2 and 3 (Sugiyama, 1997) of 2-8cm thick limit the top of each part. The lower part of the section (21 m in thickness) is mainly composed of rhythmical bedded brick-red chert. This part is characterized by late Anisian to early Carnian (TR 2C to 5A) radiolarian assemblage. Conical Nassellarians are dominant in lower horizons of this part. The middle part of 22 m thick is dominated by amalgamated greenish gray chert. The common occurrence of the striped cherts characterizes the middle part. These striped cherts occur the most commonly in the midst of the middle part and decrease in number downward and upward. The assemblage from this part indicate early Carnian to early Norian (TR 5A to 6B). Spherical Spumellarians are dominant in the midst of this part. The upper part (12 m in thickness) is alternation of rhythmical bedded red chert and amalgamated greenish gray chert. The rhythmical bedded chert sequence is similar to the lower part. The amalgamated bedded chert sequence looks like the middle part, however, the striped chert is very few. Three white chert layers are observed. Radiolarian assemblages from the upper part indicate early Norian to early Rhaetian (TR 6B to 8C). Characteristic radiolarian taxa include Japonocampe nova (Yao), Podobursa sp., Syringocapsa batodes De Wever, Paronella norica Kozur and Mock, Poulpus curvispinus Dumitrica, Kozur and Mostler, P. piabyx De Wever, Sarla vetusta Pessagno, Capnuosphaera deweveri Kozur and Mostler, C. sagaris Sugiyama, C. colemani De Wever, Capnodoce anapetes De Wever, C. sarisa De wever, Praeheliostaurus laevis Kozur and Mostler, Xipha nodosa Sugiyama, Trialatus robustus (Nakaseko and Nishimura), Lysemelas olbia Sugiyama, Parentactinocarpus sevaticus Kozur and Mostler, P. tetracanthus Dumitrica, Praemesosaturnalis multidentatus (Kozur and Mostler), P. pseudokahleri Sugiyama, P. heilongjiangensis Yang and Mizutani and Dreyericyrantium ithacanthum Sugiyama. The TR6B-7 radiolarian Zonal boundary is situated slightly above CS-2. TR6B assemblage is dominated by spherical Spumellarians. On and above the top of TR6B, saturnalid Spumellarians are strongly diversified. This saturnalid high diversity continues to late Norian. Rhaetian assemblages are characterized by Deflandrecyrtiidae Nassellarians.

Keywords: chert, Late Triassic, radiolarian fossils, Sakahogi section, Mino Terrane, Panthalassa

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MIS025-04

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Reconstruction of Os isotope record of the Triassic seawater based on chert samples from the Sakahogi Section, Mino Belt

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We reconstruct the secular change of the Triassic marine Os isotope record based on the chert samples, Sakahogi Section, Mino Belt. The Sakahogi section is one of the most suitable sections in order to decipher paleo-ocean environmental change due to its perfectly continuous stratigraphy ranging from the Early Anisian to Early Rhaetian (ca. 40 Myr). Our main goals are (1) understanding the amplitude of the Os isotope variation in the Triassic seawater, (2) comparing the marine Os isotope record with that of Sr isotope and (3) elucidating the paleo-ocean environmental change based on the Os isotope record together with whole-rock major and trace element geochemistry.

Keywords: Os isotope composition, Triassic, paleo-ocean environment, chert, Sakahogi Section, Mino Belt

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Iridium anomaly, Ni-rich spinels, and microspherules in Upper Triassic chert of the Mino Terrane, Central Japan

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An important ~30 Myr interval during the Late Triassic is marked by the formation of several large impact structures on Earth, including the 100-km-diameter Manicouagan crater in Canada, which is one of the largest known Phanerozoic impacts. Although the age of the Manicouagan structure is well constrained by U-Pb dating (~215.5 Ma), deposits containing its ejecta are known only from southwestern Britain. Here, we report that an Upper Triassic chert in Japan, deposited within the Paleo-Pacific (Panthalassa) pelagic basin, contains Iridium anomaly, Ni-rich spinels, and microspherules that are characteristic of impact ejecta.

Microspherules were discovered from a claystone layer (~5 cm thick) in an Upper Triassic bedded chert succession of the Sakahogi section, Mino Terrane, Japan. An analysis of radiolarian fossils reveals that the claystone layer is correlated with the early to middle Norian stage of the Upper Triassic. The base of the layer contains 10-15% (by rock volume) green microspherules. Microspherules range in size from 200 to 300 microns. Synchrotron X-ray diffraction analysis indicates that the microspherules are composed mainly of clinoclore. Some microspherules contain a high proportion of small, euhedral to subhedral crystals of oxidized Ni-rich spinels. They are distinguished from typical igneous spinels by high contents of NiO and Fe³⁺. The geochemical signals of extraterrestrial impact are recorded in the claystone layer. Examination of the clay layer using a multiple gamma-ray analysis system after neutron activation reveals that microspherules and Ni-rich spinels occur associated with an iridium anomaly, which levels comparable with those at the Cretaceous-Paleogene boundary. A scanning X-ray analytical microscope analysis shows high concentrations of siderophile elements such as nickel and cobalt, which would be expected from an extraterrestrial source.

The discovery of Iridium anomaly, microspherules, and Ni-rich spinels in early to middle Norian claystone from Japan suggests an important sedimentary record of an extraterrestrial impact in the Late Triassic. Although the Manicouagan impact structure would appear to be related to deposition of the claystone, based on an age for the crater of ~215.5 Ma, the chemical composition and mineral assemblage of the microspherules differ from those of hollow illitic microspherules reported from southwestern Britain, which are considered to be derived from the Manicouagan. Additional research is needed to confirm the source for the early Norian claystone layer in Japan, as well as to constrain the origin of the clinoclore microspherules and Ni-rich spinels.

MIS025-06

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Stratigraphic age of the ejecta deposit from the Sakahogi section in the Mino Terrane, central Japan

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The Late Triassic is marked by four impact craters, including the 100-km-diameter Manicouagan crater, which is second largest impact crater in the Phanerozoic. Previous researchers suggested that these Late Triassic impact craters could be associated with an extinction event at the Triassic/Jurassic boundary or with an earlier extinction at the Carnian/Norian boundaries in the Late Triassic. In order to investigate the possible connection between the Late Triassic extinctions and the impact events, it is necessary to date the crater formation age and to find the stratigraphic record of the impact ejecta layer within a fossil-bearing stratigraphic sequence. Although, the age of the Late Triassic impact structures has been constrained by U-Pb dating, deposits containing their ejecta are known only from non-marine section in southwestern Britain.

We report that an Upper Triassic deep-sea deposit (bedded chert) in Japan, deposited within the Paleo-Pacific (Panthalassa) pelagic basin, contains microspherules, Ni-rich spinels, and iridium anomaly that are characteristic of distal impact ejecta. These indicators of extraterrestrial impact were discovered from a claystone layer in an Upper Triassic bedded chert succession of the Sakahogi section, Inuyama area, central Japan. The age of the impact-related claystone is constrained by the presence of radiolarians and conodonts. We recognized 18 radiolarian species across the claystone. The claystone layer lies between pelagic chert layers of the radiolarian zones *Capnodoce-Trialatus* and *Trialatus robustus-Lysemelas olbia*. The last occurrence of *Trialatus robustus*, which indicates the Lacian (Early Norian), is a good indicator of the ejecta deposit. *Capnodoce serisa* and *Xiphosphaera fistulata* and the co-occurrence of these taxa clearly indicate the late Lacian to early Alaunian (Middle Norian) age for the examined part of the Sakahogi section. Small numbers of conodonts from the claystone include *Mockina medionorica*, indicating an early Alaunian age (*Mockina medionorica* Zone). Therefore, the Lacian-Alaunian boundary in the Sakahogi section can be located around the *Capnodoce-Trialatus* and *Trialatus robustus-Lysemelas olbia* Zone boundary.

An analysis of microfossils reveals that the ejecta deposit occurs around the Lacian/Alaunian boundary of the Norian Stage of the Late Triassic. Although there are no radiometric age data for the Lacian/Alaunian boundary, it has been assigned an age of ~215 Ma based on the astronomically tuned geomagnetic polarity time scale. The stratigraphic age of this ejecta deposit also reveals that this impact event is not related to either the Triassic/Jurassic or Carnian/Norian boundary extinction, but its age explains significant biotic turnovers and environmental changes occurred around the Lacian/Alaunian boundary.

MIS025-07

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Depth distribution and seasonal faunal change of living radiolarians in the Japan Sea off Sado Island (2005-2006 years)

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Work on radiolarians of the Japan Sea off Sado Island is progressing favorably by the second author (A. Matsuoka) and collaborators, from a base at the Sado Marine Biological Station administered by the Faculty of Science, Niigata University, Japan. Since the introductory study by Matsuoka et al. (2001), various studies of living radiolarians in the Japan Sea have targeted aspects of biosystematics and faunal composition (Kurihara et al., 2006, 2007, 2008; Kurihara and Matsuoka, 2009, 2010). We here present the depth distribution and seasonal faunal change of living radiolarians (June to September 2005 and 2006) in surface-subsurface waters (< 100 m depth) in the Japan Sea, off Tassha, Sado Island.

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Keywords: radiolaria, Japan Sea, depth distribution, seasonal faunal change

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The occurrence of living biserial planktic foraminifera from offshore in the Pacific ocean

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Planktic foraminifera *Streptochilus globulosus* and *Streptochilus globigerum* are the biserial planktic foraminifers living in modern ocean. The one of them, *S. globulosus* in the Pacific ocean had only reported from surface sediments in the equatorial regions, but this species is sometimes confused as genus *Bolivina*, one of the benthic foraminifers. Here we show the first report of occurrence of *S. globulosus* from the temperate and oligotrophic subsurface water in the Pacific. Four individuals in total of *S. globulosus* were recovered from 200-300 m water depth in Sta. S1 (30N, 160E) during R/V *Mirai* cruise on early winter in 2010 by using vertical plankton tow and never occurred from other water depths. According to the scanning electron microscope (SEM) observations, all specimens were juveniles. The location of Sta. S1 was sufficiently deep and far offshore from the land, therefore this species should be having planktic habitat in the water column. We subsequenced the small subunit ribosomal DNA (SSU rDNA) to identify the lineage of planktic foraminifera and it will be presented on this presentation.

Keywords: Planktic foraminifera, benthic foraminifera, biserial planktic foraminifera, Pacific ocean, evolution

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MIS025-09

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The evolution of the Pacific Ocean during the Cenozoic

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We are preparing to understand the evolution of the Pacific Ocean during the Cenozoic by the Deep Sea Drilling Project/Ocean Drilling Program (DSDP/ODP) cores obtained from more than 60 sites. Depth profiles of seafloor sediments which cover a major portion of the Pacific Ocean will give us temporal-spatial constraints on the evolution of the Pacific Ocean. Here we talk about our future plan to analyze these core samples.