Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS30-01 Room:304 Time:May 26 09:00-09:15

Biostratigraphy and carbon isotope stratigraphy of the Olenekian-Anisian pelagic deep-sea section from Ogama, Ashio Belt

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The recovery of life after the end-Permian mass extinction occurred around Anisian (early Middle Triassic). At the Olenekian-Anisian (Lower-Middle Triassic) boundary (O-AB), the lithologic change from claystone dominant facies to radiolarian-rich bedded chert facies has been reported from the Panthalassic pelagic deep-sea sediments in Japan. This trend has been interpreted to reflect a biotic recovery of the pelagic Panthalassa (Isozaki, 1997, Takahashi et al., 2009). However, spatial variations in the lithofacies of these pelagic deep-sea sediments have seldom been investigated in detail, due to the scarcity of well-preserved sections. This study reports a high-resolution microfossil- and carbon isotope-based stratigraphy around the O-AB from a new pelagic deep-sea section (Ogama section) situated in the Tochigi Prefecture, eastern Japan. The lower 8.5 m of the Ogama section is composed of alternating claystone and chert, while the upper 9 m is composed of bedded chert. Age diagnostic fossils show that the alternating claystone and chert interval can be correlated to the Spathian (upper Olenekian: uppermost Lower Triassic) to middle Anisian (lower Middle Triassic), and the bedded chert interval to the middle (to upper) Anisian. Organic carbon isotope values show a positive peak near the lowest occurrence of the conodont Ch. timorensis. This fact accords with the carbonate carbon isotope record reported from shallow-water marine carbonate sections.

The lithological transition from alternating claystone and chert to bedded chert facies near the OA-B has also been reported from the well-studied sections in the Inuyama area, Central Japan (compiled in Ikeda et al., 2010). Although the timing of this lithologic transition is roughly coincident for the two study areas, a conspicuous difference in lithology is observed around the O-AB. In the Ogama section, the O-AB falls within a 4 m thick, organic-rich black claystone dominant interval. In contrast, the O-AB interval in the Inuyama area is composed mainly of grey siliceous claystone. This suggests that production and/or preservation of organic matter was greater at the depositional grounds of the Ogama section. Further comparison of lithologic characters of the two study areas could promote the understanding of the pelagic oceanic environments around the O-AB.

Keywords: Olenekian-Anisian boundary, Conodont, Radiolarian, Carbon isotope

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MIS30-02 Room:304 Time:May 26 09:15-09:30

Non-sulphidic anoxic conditions in the end-Early Triassic deep sea

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This study focuses on an upper Lower Triassic (Spathian) to lowermost Middle Triassic (Anisian) section representing the central Panthalassic deep sea. Analysed organic carbon isotope ratio ($\delta^{13}C_{org}$) records from the section demonstrate that lower values in the Spathian increase by up to 6 ‰ at the Spathian – Anisian transition. This trend accords with the carbonate carbon isotope ($\delta^{13}C_{carb}$) record from shallow water carbonate sections. The end of the Early Triassic trough of $\delta^{13}C_{org}$ consists of black chert deposits sandwiched by black claystone beds in the study section. In these black-coloured beds and underlying siliceous claystone beds, higher concentrations of redox-sensitive elements, such as Mo and V, and coinciding low sulphide sulphur isotope ratios ($\delta^{34}S_{sulphide}$) and previously reported sulphur-bearing organic compounds are present, suggesting anoxic deep water. As enrichment factors of Mo are not higher than the typical sulphidic trend, these anoxic conditions did not become sulphidic. Oxygen-poor conditions coinciding with a carbon isotope trough have been also reported in late Early Triassic strata from shallow-water sections. These coincidences imply global environmental perturbations related to the delayed recovery of life after the end-Permian mass extinction.

Keywords: pelagic deep-sea, oceanic anoxia, trace element, Triassic, carbon isotope

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MIS30-03 Room:304 Time:May 26 09:30-09:45

Stratigraphy and age of stratiform manganese deposits in the Chichibu Belt, Japan

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The chert-hosted manganese deposits have been known to occur in the Triassic to Jurassic chert or chert-greenstone complex within a Jurassic accretionary complex, Chichibu Belt, southwest Japan. In order to reveal the specific age of the manganese deposits, this study investigated the occurrence and depositional age of the seven localities of manganese deposits (Taura, Tinu, Takahama, Kubodomari, Takahira, Kakinoo, Akimoto) in Saiki and Takachiho areas in the Chichibu Belt of eastern Kyushu.We also performed XRF analyses to infer the origin of manganese deposits.

Triassic and Jurassic radiolarian fossils were obtained from the 6 samples of the chert bed below the manganese deposits in the three localities (Takahama, Takahira, Akimoto). In Takahira locality, the manganese deposit occurs above the massive chert with akashiro silicastone. The red bedded chert above the manganese deposit yields radiolarian fossils such as; *Trialatus longicornutus* and *Poulpus carcharus*. These radiolarians show that age of manganese deposits can be correlated with the late Carnian age. In Takahama and Akimoto localities, the bedded chert above the manganese deposit is gray and occurs the Lower Jurassic radiolarian fossils (e.g., *Trillus elkhornensis* and *Tricolocapsa plicarum*). The XRF analysis revealed that the geochemical features of the manganese deposits in the study area is geochemically similar to the modern submarine hydrothermal manganese deposits. Consequently, manganese deposits in the eastern Kyushu were deposited by hydrothermal activity in an open-ocean setting around the late Carnian and Early Jurassic. The large volumes of flood basalts were erupted in the Carnian and Early Jurassic, and their ages are consistent with the depositional ages of the manganese deposits from the Chichibu Belt in eastern Kyushu.

Keywords: Chichibu Belt, stratiform manganese deposits, radiolarian biostratigraphy, Upper Triassic, Lower Jurassic, volcanic activity

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MIS30-04 Room:304 Time:May 26 09:45-10:00

Chemostratigraphy of the Middle Triassic bedded chert sequence in the Mino Belt, central Japan

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Previous studies have proposed that the alterations of chert and shale beds in the bedded chert sequence of the Japanese Jurassic accretionary complex are paced by precession and eccentricity cycles, especially chert bed thickness variation is interpreted as productivity fluctuations. However, the cyclostratigraphic interpretations and the continuity of sequence between sections await further verification (Ogg, 2014). In this study, we focus on shale beds as geochemical proxies for stratigraphic correlation and paleoclimatological interpretation. Then we conducted geologic survey at Section M, CH2L, L, and B (Anisian and Ladinian based on detailed radiolarian biostratigraphy by Sugiyama, 1997), reconstructed the composite column using stratigraphic correlation of lithological associations between sections, and collected shale bed samples with bed by bed resolution for geochemical analysis (more than 500 samples). The reconstructed lithostratigraphy of the Middle Triassic bedded chert sequence consists of lower gray bedded chert, lower red bedded chert, upper gray bedded chert, and upper red bedded chert in ascending order (Ikeda et al., 2010). The elemental compositions in shale beds are determined by XRF analysis. In presentation, we will discuss about the geochemical characteristics of shale beds, the chemostratigraphy of the Middle Triassic bedded chert sequence, and their implications.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS30-05 Room:304 Time:May 26 10:00-10:15

Carbon isotope record from the Upper Triassic bedded chert in the Mino Belt, central Japan

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The Late Triassic was characterized by several marine and terrestrial biotic turnover events prior to the end-Triassic mass extinction. The causes of the end-Triassic mass extinction and these Norian to Rhaetian biotic turnover events are still the subject of debate. In order to infer the Norian to Rhaetian (Late Triassic) environmental changes in a pelagic realm of the Panthalassa Ocean, the stratigraphic variations of TOC and δ13C$_{org}$ of the bedded chert succession in the Sakahogi section were examined. The Sakahogi section (~26 m in thickness) crops out in the Mino Belt, central Japan, and consists of the red to greenish-gray bedded chert. The radiolarian biostratigraphy indicates a middle Norian to Rhaetian age of the bedded chert. The bedded chert of the Sakahogi section is reconstructed as a deep-sea sediment of pelagic facies forms in an open ocean realm of the Panthalassa Ocean. Our analysis shows that the middle Norian samples record stable vaues until the late middle Norian. This stability is disturbed by a small negative δ13C$_{org}$ excursion at the middle Norian ejecta layer (Sakahogi ejecta). TOC values increase across the middle and upper Norian boundary interval. This interval is marked by a minor increase in δ13C$_{org}$ value (~1 ‰).

Keywords: Triassic, bedded chert, carbon isotope

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS30-06 Room:304 Time:May 26 10:15-10:30

Deep-ocean acidification and volcanism across the Triassic-Jurassic extinction event

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Triassic-Jurassic (T-J) extinction event marks one of the Big Five mass extinction events of the Phanerozoic. The emerging consensus points to volcanic activity at the Central Atlantic Magmatic Province (CAMP) as the ultimate cause of the extinction, yet the underlying nature of global environmental changes that accompanied the biotic turnover remain elusive. We present chemical and mineralogical studies across the T-J transition of the deep-sea chert sequence (Inuyama, Japan). Depleted hematite content normalized by terrigenous material occurred just before the T-J extinction with significant change in color from brick red to purple. This suggests the loss of authigenic hematite due to the deep-ocean acidification, which is consistent with the rock magnetic records of Abrajevitch et al. (2013). This timing is consistent with the CAMP volcanism, implying a catastrophic release of greenhouse gases as causes of deep-ocean acidification. Across the T-J transition, MgO/Al2O3, Fe2O3/Al2O3, and Al2O3/SiO2 increased with change in color from brick red to dusty red. These geochemical trends are consistent with those of weathered CAMP basalts in arid area (Dal Corso et al., 2014), implying that weathered CAMP basalts became the considerable source of aeolian dust in pelagic Panthalassa after the T-J extinction event.

Keywords: Triassic/Jurassic, acidification, volcanism, extinction

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS30-07 Room:304 Time:May 26 10:30-10:45

Carbon and oxygen isotopes record of Upper Triassic limestone in the Kardolina section, Slovakia

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Triassic / Jurassic (T/J) boundary of approximately 201.3 million years ago is known as a stratigraphic boundary recorded one of the big five Phanerozoic mass extinctions. Catastrophic processes such as widespread eruption of the Central Atlantic Magmatic Province (CAMP) flood basalts and extraterrestrial impacts have been proposed to account for the mass extinction event. This paper reports the results of carbon and oxygen isotopes analysis from the uppermost Triassic limestone in the Kardolina section, Slovakia. The Kardolina section is crops out on a steep western slope of the Mt Palenica in the Belianske Tatry Mts as the most continuous section from the uppermost Triassic (Rhaetian) Fatra Formation. The Fatra Formation is shallow marine carbonate sequence and is overlain with a sharp contact by marine shale of the lowermost Jurassic (Hettangian) Kopieniec Formation. The Rhaetian age of the Fatra Formation was determined by foraminifera fossils. Several excursions of carbon and oxygen isotopes exist in the Fatra Formation. The large negative carbon isotope excursions (CIE) were found in at least four stratigraphic levels. Although the Fatra Formation is composed of packstone and grainstone, the CIE occurred during the deposition of non-fossiliferous lime-mudstone or ostracod lime-mudstone. The largest negative CIE occurs just before the T/J boundary. The cause of this negative CIE at the vicinity of T/J boundary remains uncertain. However it is assumed that the Kardolina section was exposed on the ground by sea-level fall, and subjected to diagenesis of terrestrial water. The large CIE may possibly be associated with sea-level change of the Kardolina section.

Keywords: carbon and oxygen isotopes, limestone, Triassic/Jurassic boundary, Rhaetian, carbon isotope excursion, sea-level change

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS30-08 Room:304 Time:May 26 11:00-11:15

Reconstruction of mid-Cretaceous oceanic plate stratigraphy in the Hidaka-cho area, South central Hokkaido

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Jurassic to Early Cretaceous accretionary complexes were formed by subduction of an old and cold oceanic plate more than 100 m.y. old. Whereas those in the Late Cretaceous and Paleogene periods formed upon a young and warm oceanic plate, which spent less than 30 m.y. from its birth to subduction. The character of the boundary between the oceanic crusts of differing ages is left unknown. Terrigeneous mudstones of the Ganpiyama Comlex (Kawamura et al., 2001) in the Kamuikotan Zone of Hokkaido Yields radiolarian fossils of late Albian to early Cenomanian (Agency for Natural Resources and Energy, 1989). This study aims to clarify the mode of connection between the old and new oceanic plates reconstructing oceanic plate stratigraphy in the Ganpiyama Complex, which might have formed in the turning point from the old to young plate subduction. This presentation will show reconstructed oceanic plate stratigraphy based on observation of fragmented sedimentary successhion and newly obtained radiolarian ages.

The Ganpiyama Complex occurs surrounded by serpentinite and underwent very low grade high-pressure metamorphism with occurenses of alkali pyroxene and aragonite (Kawamura et al., 2001). This complex consists mainly of terrigenous clastic rocks such as black mudstone and broken turbidites, with lesser amounts of oceanic rocks such as metabasalt and chert. Fragmental sedimentary successions e.g. from metabasalt to chert, and chert via alternation of chert and siliceous mudstone to terrigenous clastic rocks are observed in many sections. These allows us to complement the original full sequence of metabasalt, red mudstone (<1 m thick), bedded chert (5-10 m) with limestone intercalations, alternating beds of chert and siliceous mudstone (1-1.5 m), and terrigenous mudstone and sandstone (>15m) in stratigraphically ascending order. Metabasalts underlying bedded chert comprise volcanic breccia associated with clasts and matrices of chert. Also found are isolated bodies of pillow and massive lava, which do not accompany with chert. In addition, there is variation in sediments overlying the metabasalt there are cases in which one of red mudstone, red chert or alternating beds of chert and siliceous mudstone covered metabasalts. Volcanic breccia with chert clasts suggest existence of high reliefs on the ocean floor and mass wasting on their slopes. Diversity of sediments overlying the breccia may also have reflected rough topography. Radiolarian fossils were newly obtained from pelagic chert and hemipelagic alternation of siliceous mudstone and chert. In spite of extensive recrystallization, early Aptian or earlier Cretaceous fauna from chert, and late Aptian to early Albian fauna from alternation of chert and siliceous mudstone were identified. The oldest limit of the chert sedimentation has not been determined well. However, it feels not so old as Jurassic taking into account the small thickness is of the chert (5-10m). The age of the subducted oceanic plate in the mid-Cretaceous is estimated as 30-40m.y, as the age difference of pelagic sediments and terrigenous clastic rocks. The old oceanic plate is thus considered to have been altered by the young one until the time of formation of the Ganpiyama Complex. Early Cretaceous accretionary complexes (Iwashimizu Complex of the Kamuikotan Zone and the Naizawa Complex of the Idonnappu Zone) both formed in ˜130Ma contain Triassic chert and limestone as suggestive of the old plate subduction. Therefore, it is considered that the boundary between the two plates passed Hokkaido during 130-100Ma.

Keywords: oceanic plate stratigraphy, accretionary complex, radiolaria

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

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Jurassic intraoceanic arc offshore Japan

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The Sorachi-Yezo Belt in central Hokkaido is based on ophiolitic rocks represented by the lower Sorachi Group including the Horokanai Ophiolite. Controversy of their origins is responsible for many unsolved problems such as reconstruction of oceanic plates and correlation to SW Japan. This paper tests a marginal basin model with a Jurassic intraoceanic arc, introducing petrology of the Gunkanyama Ophiolite complex in the Mitsuishi area, southern Sorachi-Yezo Belt.

The Mitsuishi area has been known as a locality of serpentinite melange with high-pressure (HP) metamorphic blocks representative of the Kamuikotan Zone. This study has revealed that the pre-Neogene rocks of this area comprise a three parallel zones of low-grade HP metamorphic accretionary complex, the Gunkanyama Ophiolite, and serpentinites melange. These rocks are unconformably overlain by Neogene deposits, and folded together. The Gunkanyama Ophiolite is regarded as an amalgamate of fault-bounded slices of plutonic-hypabyssal complex, ultramafic cumulate, and partly serpentinized harzburgite. No effusive and sedimentary rocks are found.

The plutonic-hypabyssal complex consists mainly of mafic cumulates and dikes, associated with minor dikes and small bodies of diorite and tonalite. 160-165 Ma (late Middle Jurassic to early Late Jurassic) zircon U-Pb ages have been obtained from these felsic rocks. Igneous rocks are dominated by basaltic andesite poor in HFS elements, suggestive of volcanic arc. Some of them are classified as boninites in composition. Taking into account the absence of continental basement rocks, the ophiolite probably originated from immature intraoceanic arc. It might have existed ocean-ward from the trench which produced the Jurassic accretionary complex in Japan, and lay upon a distinct plate from the Triassic or older oceanic plate responsible for Jurassic and Early Cretaceous accretionary complexes and the Kamuikotan blueschist metamorphism.

The lower Sorachi Group (& Horokanai Ophiolite) shows no trace of island arc activity in the Jurassic period, with basalts with MORB or OPB chemical affinity. Genetic relationship between the Gunkanyama and Sorachi ophiolites are thus left unknown. However, it is not difficult to speculate that these coeval ophiolites with similar geotectonic positions together belonged to a single plate. This leads to a hypothesis that they comprised an arc - backarc system.

Keywords: oceanic plate paleogeography, Jurassic, ophiolite, inraoceanic arc

Japan Geoscience Union Meeting 2015
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MIS30-10 Room:304 Time:May 26 11:30-11:45

What does the radiolarian Spumellaria/Nassellaria ratio indicate?

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Spumellaria and Nassellaria are major orders in radiolarians. The Spumellaria/Nassellaria ratio has been used in monitoring environmental changes in the past oceans. However, what the ratio indicates is not well understood. It is noteworthy to point out that the ratio is strongly affected by taphonomic processes and careful application is needed. Detailed observations of a variety in feeding behavior of cultured radiolarian specimens make it possible to understand the relationship between skeletal morphology and feeding behavior. Multi-segmented nassellarians require much larger prey than any other radiolarians. The ratio of multi-segmented nassellarians to total radiolarians is regarded as another proxy in monitoring ecosystem in the pelagic realm.

Keywords: radiolaria, Nassellaria, Spumellaria, paleoenvironment, proxy, pelagic realm

Japan Geoscience Union Meeting 2015
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Trace fossils of Ordovician chert and siliceous rocks from Newfoundland, northeastern Canada

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Sudden and continuous increase in biodiversity in Ordovician is named as ”Great Ordovician Biodiversification Event” (Webby, 2004). But the evolution of benthic animals in pelagic realm remained unstudied. One of the typical sediment of the pelagic ocean bottom is radiolarian chert, and the studies on the chert and the associated siliceous rocks especially on trace fossils recorded in those rocks are essential. Records of trace fossils in the upper Cambrian to the upper Ordovician chert and siliceous rocks are examined in detail that is summarized as follows; tiny and simple ones in the Late Cambrian increase their size and morphological varieties in the late Middle Ordovician (Kakuwa & Webb, 2007; 2010), and the result is supported by Percival (2012). This presentation reports the Canadian case.

Chert and siliceous sediments had been deposited by the spreading and deepening of Iapetus Ocean, and the rocks are exposed in the Newfoudland, northeastern Canada. Examined are three rock units; (1) Shoal Arm Formation, which is composed of red chert, gray chert and black shale in ascending order, conformably overlies the volcanic rocks of the Wild Bight Group, and is conformably overlain by turbidite sandstone of the Gull Island Formation, Badger Group. The age of the chert of Shoal Arm Formation is almost correlated to the N. gracilis zone that is correlated to early half of Sandbian (Caradocian). (2) Strong Island Chert, which is composed of argillaceous chert and siliceous mudstone with some turbidite sandstone interbeds, overlies tholeiitic and alkaline pillow lava and pillow breccia of the Lawrence Head Formation. The age is correlated to the basal Darriwilian to lower Sandbian. (3) Sanders Cove Formation, which is composed of red and green siliceous mudstone, chert (silicified tuff?) and volcaniclastic sandstone turbidite overlies volcanic rocks of the Tea Arm Formation. The age is Tremadocian to Dapingian. All the geologic information is based on O’Brien (2012).

These three units of Ordovician siliceous rocks are not comparable to the typical pelagic sediment of the deep-sea ocean, but the general evolutionary trend of the trace fossils is consistent with the Australian case. The lower Ordovician siliceous rocks of the Sanders Cove Formation bears only small and tiny burrow tunnels of Planolites-type. And small and simple burrow tunnels of Planolites-type both in the lower section of the Shoal Arm Formation and the Strong Island Chert change to large burrows such as Teichichnus-type in the upper section.

This general evolutionary trend is overlapped by the development of the basin and/or local changes in the environment. The early stage of the formation of the basin allowed only small and simple type burrows even in an oxidized basin of the Late Ordovician time. Frequent anoxic events in the later half, on the other hand, interrupted the oxygenated environment of large Teichichnus-type burrows.

Keywords: trace fossil, Ordovician, chert, Canada, Teichichnus, evolution

Japan Geoscience Union Meeting 2015
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MIS30-12 Room:304 Time:May 26 12:00-12:20

Molluscs in pelagic realm: general characteristics in morphology and ecology

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Molluscs are the most thriving living animals in the ocean, and their fossil records are rich and continuous from the Cambrian to Holocene. The majority of molluscan groups are benthic, but part of them have adapted to a planktonic or pelagic life. Notable examples include pteropods, heteropods, janthiniids and several genera of nudibranchs in gastropods. In cephalopods, many species are pelagic or actively swim. These non-benthic molluscs segregate their habitats from the epipelagic to abyssopelagic zones, and a large number of species are known to migrate vertically. Their life habit is regulated by numerous environmental factors such as light, nutrients, temperature and water pressure. A specialized mode of life often has severe constraints in morphological diversity: species in pelagic realm are characterized by a thin-shelled or shelless body, a limited spectrum of coloration, sensitivity to illumination, and buoyancy control. These general characteristics are manifested particularly by comparison with those of benthic species.

Keywords: pelagic realm, Mollusca