

Relationship between the Kamiaso unit and the Nabi unit in the Mino terrane of the Mino-Seki area, Gifu Prefecture

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The Mino terrane, one of the disrupted terranes in central Japan, is divided into several tectonostratigraphic units on the basis of composition, fabric and age. However, there is a problem that these data are biased, because detailed studies have been conducted only in limited areas. The Mino-Seki area of the central part in Gifu Prefecture is one of such area. According to Wakita (1988b), this area is occupied by the Kamiaso unit characterized by repeating coherent chert-clastic sequences and the Nabi unit characterized by broken formation composed of sandstone / mudstone and melange. The Wadano Conglomerate (Kanuma, 1956), characterized by breccias of chert, siliceous claystone, limestone and basaltic rocks, is also distributed in the study area. Here, I will discuss relationship between the Kamiaso unit and the Nabi unit in the Mino terrane.

As a result of a detailed field work, accretionary complexes in the Mino-Seki area are divided into a coherent unit (Kamiaso unit), melange unit (Nabi unit) and the Wadano Conglomerate. The Kamiaso unit is characterized by a tectonic pile composed of chert-clastic sequences that retain the oceanic plate stratigraphy. Chert samples yield Middle Triassic to Early Jurassic radiolarians, while mudstone samples yield Early Bathonian radiolarians. The Nabi unit includes melange and alternating beds of chert and siliceous micrite. There are also differences in the lithology of chert. Black chert with weathered red surface is commonly found in the Nabi unit especially along the Nagara River. These lithofacies generally are not recognized in the Kamiaso unit. Chert samples yield Middle Triassic to Early Jurassic radiolarians, while siliceous mudstone samples yield Middle Jurassic radiolarians. A chert sample in alternating beds of chert and siliceous micrite yields of Late Triassic radiolarians. Igo and Koike (1975) reported Late Norian conodonts from a limestone sample in alternating beds of chert and limestone. The Wadano Conglomerate consists mainly of conglomerate and massive sandstone. It is characterized by blocks of basaltic rock chert, siliceous claystone, and limestone. The Upper Triassic siliceous micrite-chert facies of the Nabi unit differs in containing siliceous micrite from the coeval chert of the Kamiaso unit. This relationship has already been pointed out by Sano et al. (2010).

Keywords: Mino terrane, Kamiaso unit, accretionary complex, chert-clastic sequence, radiolaria

Recognition of the Olenekian-Anisian Boundary Sequence from Ogama, Ashio Belt

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Pre-Jurassic pelagic sedimentary sequences are known to have accumulated in the pelagic Panthalassa over millions of years (Matsuda and Isozaki, 1991; Ando et al., 2001). These pelagic sequences are considered to preserve environmental record of the pelagic Panthalassa. However, spatial variations of pelagic sequences are not fully understood, due to the scarcity of well-preserved sequences. In order to face this problem, this study reconstructed the stratigraphic sequence ranging from Lower to Middle Triassic with high resolution at the Ogama section of the Ashio Belt, which is located in Tochigi, Japan (Kamata, 1996; Kamata 1997).

The section consists of three parts, which occur in separate outcrops; Og-A section, Og-B section and Og-C section. The boundaries of these outcrops were not directly observed, but the major difference in lithology suggests that these outcrops are in contact with faults. The Og-A section consists of approximately 2.5 m thick black claystone overlain by bedded chert. The Og-B section consists of alternating claystone and chert. Claystone in the Og-B section has two types: black claystone and grey siliceous claystone. The Og-C section consists entirely of bedded chert. Components of bedded chert are 1 to 10 cm thick chert beds and 2 to 25 mm thick intercalated claystone beds.

Age diagnostic conodonts were recovered from the Og-B section. Spathian conodonts indicating the *Triassospathodus homeri* zone (*Neospathodus homeri* zone; Koike, 1981), early Anisian conodonts indicating the *Chiosella timorensis* zone (*Neogondolella timorensis* zone; Koike, 1981), Middle Anisian conodonts indicating the *Neogondolella bulgarica* zone (Koike, 1981) were recovered. Radiolarian fossils were recovered from the Og-C section. Early-middle Anisian radiolarian *Triassocampe eruca* (Sugiyama, 1997) and late Anisian radiolarian *Triassocampe coronata* (Bragin) group were recovered.

The reconstructed stratigraphic sequence spans from upper Spathian of Lower Triassic to upper Anisian of Middle Triassic. The Spathian-Anisian boundary determined by the first occurrence of conodont *Ch. timorensis* is placed at the lower part of the Og-B section. The Lower to Middle Triassic pelagic sequence of the Ogama section has two important characteristics. One is the lithofacies change from claystone dominant facies of upper Spathian to bedded chert facies of middle Anisian. The other is the 4 m thick interval of black claystone and black chert, which spans from uppermost Spathian to lower Anisian.

Lower to Middle Triassic pelagic sequences are also exposed in other Jurassic accretionary complexes. A particularly well-studied sequence belongs to the Mino Belt, and is situated in the Inuyama area, Gifu, Japan. This area has been the target of intensive biostratigraphical examinations (Sugiyama, 1997; Yao and Kuwahara, 1997) and cyclostratigraphical researches (Ikeda et al., 2010). The comparison of the two pelagic sequences from the Ashio Belt and the Mino Belt revealed the common general trend of increasing chert content within the lower to middle Anisian interval. However, it is also noteworthy that the interval consisting of black claystone and black chert is remarkably thicker in the Ogama section than in the Inuyama area. Takahashi et al. (2009) indicated the uppermost Spathian interval consisting of black claystone and black chert in the Inuyama area is the result of an oceanic anoxia. The thicker interval at Ogama section may represent longer duration of this event, or a greater sedimentation rate during the event, at the depositional setting than that of Inuyama area. Further correlations by biostratigraphy and carbon isotope stratigraphy are required to compare the onset and offset timing of this event in both depositional settings. The comparison of timing between the two sections may reveal the cause of this regional difference in pelagic sequences.

Keywords: Ogama section, Ashio Belt, Olenekian-Anisian Boundary, Conodont, Radiolarian, Equatorial Panthalassa

Upper Triassic conodont, ammonoid, and radiolarian biostratigraphy in a pelagic sequence of Japan

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The chronology for the Triassic pelagic deposits in the Panthalassa Ocean is based on the radiolarian zonation, which is well studied in the Middle and Upper Triassic bedded chert successions in the Japanese accretionary complex. Although accurate calibration for the chronostratigraphic stages and substages are established basically by means of ammonites and conodonts, most of the Japanese radiolarian zones were calibrated through correlation with zonal schemes in other regions, and have not been calibrated with ammonoid and conodont biostratigraphy. Here we present the results of Late Triassic (Carnian-early Norian) conodont biostratigraphy from the two pelagic sections in the Jurassic accretionary complex of southwest Japan. Samples for this study were collected from the Sakahogi section of a bedded chert sequence in central Japan and the Nakijin Formation of a pelagic limestone sequence in the northern tip of the Okinawa Island. We found 56 platform conodonts from 36 samples in the Sakahogi section, where the radiolarian biostratigraphy have previously been investigated. The biostratigraphy of the Carnian-Norian sequence of the Nakijin Formation is based primarily on ammonites, since the rare occurrence of conodonts minimizes the stratigraphic potential of these groups. However, our study revealed that the clastic limestones intercalated within the Nakijin Formation contain rich conodonts assemblages. Based on detailed study of the conodont biostratigraphy from the interval of the Carnian and the early Norian in the Sakahogi section and the Nakijin Formation, three conodont zones are recognized in ascending order as follows: lower Carnian *Paragondolella praelindae* - *Metapolygnathus polygnathiformis* zone, upper Carnian *Metapolygnathus lindae* - *Metapolygnathus primitius* zone, and lower Norian *Epigondolella quadrata* zone. This result is consistent with the presence of the lower to upper Carnian ammonites assemblages in the Nakijin Formation.

Keywords: Late Triassic, Carnian to early Norian, conodont, ammonoid, and radiolarian biostratigraphy, Sambosan Terrane, Mino Terrane, Panthalassa Ocean

Toward reconstruction of oceanic plate paleogeography in the NW Pacific: a subject from the NE Japan arc.

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Spatial distribution of oceanic plates in the Mesozoic NW Pacific has been indirectly assumed extrapolating from magnetic anomalies tracked back to the mid-Pacific. However, common occurrences of suprasubduction ophiolites and arc terranes, existence of the Philippine Sea plate originated in the Jurassic, and lower mantle tomography suggesting remnants of subducted slab in the mid-Pacific all imply that plates occupied NW Pacific were distinct from those in the middle to east Pacific in the Mesozoic. To test this possibility, it is important to reconstruct oceanic plates from geology and chronology of accretionary complexes and ophiolites independently from the traditional methods based on magnetic anomaly. Here we present a subject for the oceanic plate reconstruction raised from NE Japan.

In this study, we determined U-Pb ages of zircons extracted from a tuff bed in a coherent clastic sequence of the Cape Shiriya accretionary complex (Shimokita Peninsula) at the northeastern tip of the North Kitakami belt. These zircons yielded a mean age of ca. 130 Ma (about Hauterivian / Barremian boundary). Almost identical ages were also obtained from the youngest zircon grains in sandstone. The 130 Ma age is concurrent with (a) Trench sedimentation in the Idonnappu accretionary zone, (b) high-P/T metamorphism in the Kamuikotan zone, and (c) island arc volcanism in the upper Sorachi Group, all in the central Hokkaido far in the east. A shift of the NE Japan trench from the North Kitakami belt to central Hokkaido has been assumed, with contemporaneous onset of arc volcanism in central Hokkaido. However, our result implies dual subduction in the both areas at 130 Ma. If this hypothesis stands, arc-trench system in central Hokkaido could have formed not along the Eurasian continental margin but belonging to another plate.

We also dated a diorite dike as a member of microdiorites, which commonly occur associated with serpentinites in central Hokkaido. These rocks have been attributed to Cretaceous arc magmatism based on chemistry and K-Ar ages. The diorite sample yielded a 160 Ma zircon U-Pb age of Late Jurassic, within the period of trench accretion in the North Kitakami belt. This age thus also suggest the hypothesis of dual subduction, where arc activity occurred outside the trench of Eurasian continental margin.

NE Japan has been held other problems difficult to be explained by simple, single subduction schemes. For example, adakite magmatism (suggesting slab melting) in the Kitakami mountains occurred contemporaneously with lawsonite-blueschist metamorphism (suggesting very cold subduction) in the Kamuikotan zone. Our new age data encourages to test possibilities that another subduction zone existed in the NW Pacific distinct from Eurasian active continental margin at least during Late Jurassic to middle Early Cretaceous.

Keywords: Pacific, oceanic plate paleogeography, zircon, U-Pb age, accretionary complex, ophiolite

Philippine sea plate motion since the Pleistocene viewed from deformed conglomerates of the Ashigara group

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On the northern convergence border of the Philippine Sea plate, Pleistocene Ashigara group (1.6-0.5Ma) filled a trough. Miocene Tanzawa group is distributed on the north side, and both are bounded with the Kannawa fault system. The Kannawa fault system is divided into the Kannawa fault (E-W direction, dextral sense) of the narrow sense, Hisari fault system (NE-SW, sinistral-normal), Nakatsugawa fault system (NW-SE, dextral-reverse), Shiozawa fault system (NE-SW, sinistral-reverse), etc. The Shiozawa formation (conglomerates) which is the high-end strata of the Ashigara group is distributed over the southeastern side of the Shiozawa fault. Parts of the conglomerates are deformed remarkably. These deformation zones are divided into six types (P-R1 cataclasite: A, B, C; fault gouge: Dr, Dg, Db) based on the fault rock property, shear sense, cutting relations. The cataclasites are distributed over the range of 600m from the Shiozawa fault. The shear sense is reverse fault mainly, but shows sinistral in a part of the B and Db type. Quartz grain becomes fine fragment by crush, and biotite does basal slip, it is thought that this cataclasite was formed under environment of 150-300 oC, and 5-10km in depth. The influence of the subducting Philippine Sea plate might have increased. In addition, the moving direction was not constant, northwest and north might be mixed in the Pleistocene age.

Keywords: Kanagawa Prefecture, Ashigara group, Shiozawa formation, cataclasite, fault gouge, Philippine sea plate

Radiolarian morphology as a proxy for reconstructing pelagic environments: problem and perspective

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Late Paleozoic and Mesozoic radiolarian cherts are widely distributed within accretionary complexes in the Circum-Pacific and Alps-Himalaya orogenic belts. These cherts are materials for reconstructing the paleoenvironment of the Panthalassa and the Tethys. Many proxies have been developed to elucidate the environment of the past pelagic realm. Species diversity in radiolarian assemblages is expected to be one of proxies for monitoring paleoenvironmental change. However, the species concept of radiolarians is not always consistent throughout the Phanerozoic time. This makes a serious problem to use radiolarian diversity for elucidating environmental fluctuations. This paper documents the present status of taxonomy for Mesozoic and recent radiolarians. Detailed morphological analysis of radiolarian tests and the understanding of the morphogenesis through culture work are clues toward reconstructing pelagic environments in the past oceans.

Keywords: radiolarians, taxonomy, species concept, morphological diversity, pelagic realm

Lifestyle of adherent benthic foraminifers in the open ocean based on stable of isotope records

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Colonization of new habitat of benthic foraminifers is related to their diversion, survival strategies and evolutions. However their dispersal mechanisms are not well documented and still poorly understood. Last year, we reported a new lifestyle of neritic benthic foraminifera: They had lived on the stems of hydrozoan attaching to observational moorings in the Pacific Ocean. This is a new insight of dispersal strategy of benthic foraminifera to the open ocean. However there are no evidences whether benthic foraminifera developed their calcareous shells in the water column or not. Here we report the new evidences of benthic foraminiferal lifestyles based on micropaleontological and geochemical methods.

Physical and biogeochemical observational mooring systems (POPSS & Sediment trap) were deployed on July, 2012 at the Station S1 (30N, 145E, water depth: 5,900m). Moored periods were from July 2012 to July 2013 (1 year). Hydrozoan attaching on the both mooring systems were observed at the surface of the winch, sensor buoy, sediment trap and float at shallower depths (~200 m) and we could not observed hydrozoan at the 500 m water sediment trap. More than 300 individuals of benthic foraminifers attached of the surface of hydrozoan body. At least, fourteen living benthic foraminifers were identified under the microscope and faunal assemblages were basically same (calcareous, agglutinated, and sessile) with that of previous year. We performed the stable isotope analysis for these calcareous specimens including some porcellanic benthic and planktic foraminifera. As the results, oxygen and carbon isotopes of calcareous benthic foraminifera showed remarkably lighter and heavier values than planktic foraminifera, respectively. It suggested that calcareous benthic foraminifera in this study built their calcareous shells at shallower water depth than planktic species.

Keywords: adherent benthic foraminifera, Stable isotopes, Lifestyle, Hydrozoan

Comparison between morphological dissimilarity and morphological richness

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Morphological disparity, another look at biodiversity, has recently attracted attention of paleontologists in the context of mass extinction and recovery. The measure of disparity has commonly been based on morphological dissimilarity between objects, e.g., sum of variance, mean pairwise distance, range of variation etc. It is widely known that this sort of disparity is robust against sample size and is not seriously affected by a nonselective extinction, whereas selective extinctions should readily reduce the disparity. On the other hand, another aspect of disparity is morphological richness, which is assessed through compilations of the number of character states; e.g., number of pairwise character-state combinations and number of morphospace divisions occupied by observation. Unlike the morphological dissimilarity, the morphological richness appears to be fairly sensitive to nonselective extinctions as well as to selective ones.

The comparison among the diversity measures based on the morphometric data obtained from the ammonoids revealed that the patterns of disparity change were totally different between dissimilarity and richness, while comparison within the same categories tended to indicate a consistent result. This result suggests that comparison between morphological dissimilarity and morphological richness provides a powerful tool to assess the selectivity of an extinction event.

Keywords: disparity, biodiversity, morphological dissimilarity, morphological richness

Is the growth hiatus of ferromanganese crusts a local or global event?

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Recent applications of an Os isotope dating method revealed that some ferromanganese crusts collected from the Pacific Ocean might have experienced the growth hiatus. However, it is still controversial whether this growth hiatus was a local or global event. In the present study, we discuss the geological trigger of this growth hiatus based on our results of the Os isotope dating on various ferromanganese crust samples collected from Northwestern Pacific, South Atlantic Oceans and Philippine Sea.

Keywords: ferromanganese crust, Os isotope, geochemistry, growth hiatus, paleoceanography

Sedimentation rate of the end-Permian to earliest Triassic black claystone strata in the Panthalassic deep-sea

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The greatest mass extinction occurred at the end-Permian, its aftermath continued during following Early Triassic. This period, especially interval between the end-Permian and Induan is characterized by occurrences of the black claystone in the pelagic deep-sea depositional area where now locate in Japan and western North America etc. This black claystone generally contains high organic matter and few silicic fossils, in contrast that bedded chert before the mass extinction event has few organic matter and abundant radiolarian tests. Detailed background of this black claystone has not been fully understood due to the scarcity of well-preserved lithologic sequences. Herein, we show preliminary achievement on continuous black claystone strata based on the one of most continuous Permian-Triassic Boundary section (Akkamori-2 section; Takahashi et al., 2009).

We polished the outcrops of the study section using hand grinders with diamond-blades and diamond-polishing pad for observation of sedimentary facies and structures. Observing the outcrop, structural geology examination was conducted (See Yamaguchi et al. in this session). Using their results, we divided the outcrop into 20 subsections that preserve continuous lithologic stratigraphy. Then, high-resolution lithologic column was reconstructed from these subsections.

After careful observation on the polished surface of the outcrop, we found many key bed layers. For instances, dolomitic layers, light and dark grey colored siliceous claystone interbedded within black claystone, and alternations of black and grey colored claystones. Using these key beds, we correlated the lithologic columns from each subsection. In the case of that useful key beds were not found, we simply built the columns up, because no duplication of strata was recognized. After these processes, totally ca. 10 m thick lithologic column of black claystone was reconstructed. Its lower most horizon accords to carbon isotopic negative excursion (Takahashi et al., 2010) coinciding with the main mass extinction event, ca. 252.2 Ma (U-Pb dating by Shen et al., 2011). Meanwhile, in the thick grey-color siliceous claystone horizon from uppermost part of the strata, conodont fossils of *Neospathodus waageni* and *Eurygnathodus costatus* were recovered. This combination indicates lowest Smithian. After interpolation by Geologic Time Scale 2012 (Gradstein et al., 2012), beginning of Smithian (end of Induan) is ca. 250.0 Ma. Using these absolute ages, sedimentation rate of black claystone is calculated 4.34mm/kyr (= 10000 mm /2300 kyr). This calculation is still comprehensive. Also, we can calculate the sedimentation rate in another way using the earliest Triassic conodont occurrence of *Hindeodus parvus* in the 7.5 m above the base of black claystone. The first occurrence horizon is estimated to be 252.3Ma in the type section of Permian-Triassic Boundary (Shen et al., 2011). The calculated sedimentation rate of black claystone in this way is 7.5 mm/kyr (750 mm/100 kyr). As the fossil age is uncertain between the basal 7.5 m interval, this is a maximum estimation. These two results of sedimentation rate indicate that the black claystone beds were accumulated in several millimetres per a thousand year. This rate is in similar class of sedimentation rate of radiolarian chert deposited before and after the black claystone deposition. In fact, recent study of Ikeda et al. (2010) concluded several centimetres thick one chert-clay couplet accords about 20 kyr. The sedimentation rate of the black claystone as similar as silicic fossil rich bedded chert before mass extinction event implies that some materials increased into the pelagic deep-sea at and after the extinction event instead of significantly decreased radiolarian tests (Takahashi et al., 2009). Possible materials are terrigenous clastic material (Algeo and Twitchett, 2009; Sakuma et al., 2012) and very fine silicic biotic crust (such as silicic sponges).

Keywords: Permian, Triassic, pelagic deepsea, black claystone, mass extinction

Stratigraphy and formation process of Late Cretaceous pelagic sediments in the Wadi Hilti area of the Oman Ophiolite

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The Oman Ophiolite consists of mantle peridotites, gabbros, a sheeted dyke complex, and basaltic lavas. The extrusive rocks have been subdivided into three volcanic units: the V1 lava with the N-MORB signature, the V2 lava formed by intra-oceanic volcanism, and the V3 lava generated by intra-plate seamount magmatism (Ernewein et al., 1988). Pelagic sediments commonly occur at the boundaries between these volcanic units. Thick sediments upon the V1 lava in the Wadi Jizzi area are subdivided into the Suhaylah and Zabyat formations; the former is composed of metalliferous and fine-grained pelagic sediments of Cenomanian-Santonian? age, and the latter consists of conglomerate derived mainly from a collapsed oceanic crust during the thrusting stage (Fleet and Robertson, 1980; Tippit et al., 1981; Woodcock and Robertson, 1982; Robertson and Woodcock, 1983).

The V2 and V3 lavas are widely distributed in the Wadi Hilti area, about 25 km west of Sohar, northern Oman Mountains. Recently, the eruption and emplacement mechanism of the V3 lava has been studied by Umino (2012). Pelagic sediments, about 50 m thick at a maximum, overlie the V2 lava and are covered by the V3 lava. The sediments also occur on and within the V3 lava. Based on our field examination for several sections in the Wadi Hilti area, the stratigraphy of the pelagic sediments on the V2 lava consists of metalliferous sediments, micritic limestone, red mudstone, conglomerate, V3 lava, and siliceous mudstone, in ascending order. We first found conglomerate containing gravels of lavas and pelagic cherts from this area. From fine-grained pelagic sediments on the V2 and V3 lavas, we obtained *Rhopalosyringium scissum* O'Dogherty and *Hemicryptocapsa polyhedra* Dumitrica that can be assigned to a Turonian age (O'Dogherty, 1994). In addition, *Rhopalosyringium petilum* (Foreman) and *Guttacapsa biacta* (Squinabol) were recovered from a block of siliceous mudstone probably within the conglomerate. According to O'Dogherty (1994), the co-occurrence of these species is restricted to be middle to late Cenomanian.

Based on these age assignments, the fine-grained pelagic sediments on the V2 lava (metalliferous sediments, micritic limestone, and red mudstone) in the Wadi Hilti area can be correlated with the Turonian part of the Suhaylah Formation in the Wadi Jizzi area. This reveals that the activity of the V2 lava was terminated in Turonian. The conglomerate and the siliceous mudstone on the V3 lava are correlated with the Zabyat Formation, indicating that the eruption of the V3 lava occurred in Turonian. These age constraints for basaltic extrusive rocks imply that the tectonic setting from subduction to oceanic-thrusting changed rapidly in a short period of Turonian time.

Keywords: Oman Ophiolite, pelagic sediments

Stratigraphy and radiolarian age of the Zabyat Formation at Lasail section in the Wadi Jizzi area, Oman Ophiolite

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The Oman Ophiolite consists of mantle peridotites, gabbros, a sheeted dyke complex, and extrusive lavas overlain by pelagic sediments. The basaltic extrusive rocks have been subdivided into three volcanic units (the V1, V2, and V3 lavas) (Ernewein et al., 1988). The overlying pelagic sediments, named the Suhaylah Formation, consist of metalliferous and fine-grained calcareous sediments of Cenomanian-Santonian? age (Fleet and Robertson, 1980; Tippit et al., 1981). The Zabyat Formation, which covers conformably the Suhaylah Formation, is composed of conglomerate derived mainly from a collapsed oceanic crust during the thrusting stage (Woodcock and Robertson, 1982; Robertson and Woodcock, 1983). Although Robertson and Woodcock (1983) investigated the sedimentation process of this formation, they did not study the biostratigraphic age of fine-grained sediments intercalated with conglomerate at Lasail section in the Wadi Jizzi area.

At Lasail section, the stratigraphy of the Zabyat Formation consists of the lower conglomerate interbedded with micritic limestone and red mudstone and the upper red mudstone and siliceous mudstone. The micritic limestone of the lower part contains *Alievium superbum* and *Rhopalosyringium scissum*, indicating Turonian in age (O'Doghterty, 1994). From the red mudstone of the upper part, we obtained *Pseudoaulophacus lenticularis*, *Pseudoaulophacus praefloresensis*, and *Theocampe salillum*. The occurrence of these species assigns the upper part of the Zabyat Formation to Coniacian (Pessagno, 1976; Bandini et al., 2008). Our biostratigraphic result of the Zabyat Formation, taken together with that of the Suhaylah Formation, shows that the change of the tectonic setting from mid-ocean ridge through subduction zone to oceanic thrusting occurred in a short period (c.a. 4 m.y.) of latest Cenomanian to Coniacian time.

Keywords: Oman Ophiolite, pelagic sediments

Deformational features of Permian-Triassic boundary preserved within an on-land accretionary complex

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Pelagic siliceous sediment covering on oceanic crust is one of the components in subduction plate boundaries where old oceanic plate subduct. Its mechanical, frictional and fluid transport properties are key to understand faulting and earthquake mechanics in such settings (Kimura et al., 2012; Yamaguchi et al., this meeting). Plate boundary deformations are strongly affected by inhomogeneity of incoming sediments: in the case of Jurassic accretionary complex in Japan (Mino-Tanba belt), siliceous/black claystone at Permian-Triassic boundary horizon within bedded chert functioned as plate boundary decollement, and only Triassic-Jurassic chert is preserved in the complex, whereas Carboniferous-Permian chert is lacking (Nakae, 1993). However, few outcrops in the Jurassic accretionary complex comprise continuous sections across Permian-Triassic boundary. To understand the limitation of lithology-controlled deformations, we investigated structural analysis of the Permian-Triassic boundary section in the North Kitakami Belt (Akkamori-2 section; Takahashi et al., 2009), where the most continuous Permian-Triassic boundary is observed.

Permian gray-color siliceous claystone to Triassic gray-color siliceous claystone through black claystone is successively observed in this outcrop (lithology detail: see Takahashi et al., this session). Orientations of 36 bedding dips, 90 low-angle cleavages, 17 high-angle cleavages, and 22 faults are measured from the outcrop. Strikes of bedding and low-angle cleavage vary NW-SE to NE-SW, gently dip eastward. Faults have two populations: one is subparallel to bedding and low-angle cleavage; the other is dipping gently to the north. Shear sense of the faults is unclear because of the lack of shear sense indicators due to intense development of overprinting high-angle cleavage.

In contrast to the scattered orientations of low-angle cleavage, strike of high-angle cleavage is limited to N40-70E with sub-vertical dip. The high-angle cleavages are recognized as axial plane cleavage of map-scale Hiraniwa-dake Syncline (Sugimoto, 1974) striking NW-SE and plunging southeastward, since the studied section is located nearby the axis of the syncline. Orientations of bedding, low-angle cleavage, and fault would be also rotated by secondary-order outcrop-scale open folds.

Hiraniwa-dake syncline involves several chert-clastics sequences in this region (Ehiro, 2008). Substrating fold-related deformations, bedding-parallel cleavages and low-angle faults (likely to be thrust) are only initial deformations observed in the studied outcrop. Those deformational features are also typical in off-scraped and underthrust accretionary complex (Kimura and Hori, 1993, Raimbourg et al., 2009). Lack of intense deformation in the black claystone suggests that not only lithology-controlled physical properties but other factors (e.g. topographic and thermal effects) would be also important to constrain the position where decollement develops.

Keywords: Permian-Triassic Boundary, subduction zone, accretionary complex, Deformation structure