Japan Geoscience Union Meeting 2011
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SGL042-01 Room:202 Time:May 23 16:30-16:45

A result of Marine Seismic exploration in deep region and Gravity investigation in the western part of Seto Inland Sea

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Japanese only

Keywords: marine seismic exploration in deep region, reflection seismic survey, refraction seismic survey, gravity investigation, median tectonic line

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SGL042-02 Room:202 Time:May 23 16:45-17:00

Folded granite with axial planar foliations, the Cretaceous Kitakami type granite, north-east Japan

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The Kitakami type granitic plutons are in the Kitakami zone. The southern and northern Kitakami zones consist of continental and accretionary facies rocks, respectively. All the rocks of the Kitakami zone possess severe pressure-solution cleavages and associated folds formed under sinistral, although lateral component was mild, transpressional stress field, but the most plutons usually have igneous textures only. Therefore deformation is basically thought to predate the plutonic intrusions. The Kesengawa granite, and some other plutons and intrusions are, however, known to have foliations penetrated by the cleavages observed in surrounding sedimentary rocks, unrelated to the outer shape of granitic plutons. We newly found tectonic fold with axial planar foliations in part of the Kesengawa granite. Granite can be folded, and because of association of newly crystallized and aligned amphiboles and biotites, folded granite can be called a gneissose granite. Furthermore, the Kesengawa pluton at least, and the Kitakami rocks, were exhumed as a whole, by giant doming associated with upright folds (associated with asymmetric parasitic folds) and their axial planar cleavages, when subducting Izanagi-Kura ridge strongly compressed the forearc and the following transform faulting overprinted the sinistral deformations. Most plutons are known to be adakitic indicating slab melting, and consequently, contrary to the probable older Kesengawa granite, not well foliated. The tectonic and igneous event is called the Oshima orogeny, and its final expression is a major and unique unconformity.

Keywords: Kitakami granitic pluton, aplite marker, asymmetric fold, axial planar foliation, exhume, ridge subduction

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SGL042-03 Room:202 Time:May 23 17:00-17:15

Relationship between detrital chromian spinels from the Paleozoic and Mesozoic clastics and ophiolite zones in the Japan

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The detrital chromian spinels in SW Japan were obtained from the Paleozoic and Mesozoic strata of the Circum-Hida tectonic zone (Renge belt), Oeyama belt, Akiyoshi belt, Maizuru belt and Mino-Tanba belt of Inner Zone, and the Kurosegawa tectonic zone (Chichibu belt) and Shimanto-Sanbagawa belt of Outer Zone. In addition, they were obtained from the similar strata of the South Kitakami belt in NE Japan. All detrital chromian spinels are categorized into two major types based on the scatter pattern on the Cr#-TiO2 diagram; alpha and beta types. alpha type is represented by a wide range of Cr#, usually 0.3 to 0.9 , and very low TiO2 content, less than 0.5, whereas beta type is characterized by a narrow range of Cr#, 0.4 to 0.6, and higher TiO2 content, 0.0 to 2.0. The occurrence of two types is different in respective belt and depositional ages of contained sediments. The detrital chromian spinels of alpha type is limited in the Paleozoic strata of the Kurosegawa tectonic zone and the South Kitakami belt as well as the Mesozoic strata of the Circum-Hida tectonic zone. On the other hand, those of beta type are restricted in the post-Carboniferous of the other belts. The chemistry of detrital chromian spinels from the Japanese Islands suggests that the sediments provenance occurred in the late Paleozoic age as evidenced from alpha type to beta type. This might be caused by the difference of formative process among accretionary complexes.

Keywords: detrital chromian spinel, ophiolite, the Japanese Islands, forearc, Paleozoic, Mesozoic

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SGL042-04 Room:202 Time:May 23 17:15-17:30

Geochronology of the Sanbagawa belt, Southwest Japan

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The high-pressure metamorphic rocks of the Sanbagawa belt, originated from deeply underplated accretionary complexes, show long and narrow distribution from the Kanto Mountains to east Kyushu. The metamorphic rocks are overlain on the south by non- to weakly-metamorphosed accretionary complexes of the Chichibu composite belt, which are, in turn, underlain by Cretaceous accretionary complexes of the Shimanto belt further on the south. The Cretaceous Shimanto belt consists, in apparently descending order, of Late Albian-Turonian (characteristically contains Triassic limestone blocks), Coniacian-Campanian, Campanian-Maastrichtian, and Maastrichtian-Paleogene units. The metamorphic or metamorphic cooling ages from the Sanbagawa belt revealed by the $^{40}Ar/^{39}Ar$ and K-Ar methods are approximately 95-60 Ma, although the peak metamorphic age and the protolith age of the eclogite unit are believed to be 120-110 Ma and Jurassic-Early Cretaceous, respectively.

In spite of the protolith age assumption of the eclogite unit, recent studies have started to show that substantial amounts of the Sanbagawa metamorphic rocks, psammitic schists in particular, have been originated from Late Cretaceous protoliths. The results of recent preliminary studies mentioned above strongly encourage the author to revise the structural division and tectonic history of the Sanbagawa belt. Hence this study aims to carry out the U-Pb age dating of detrital igneous zircons in the Sanbagawa psammitic schists.

The author measured the age of detrital igneous zircons from 18 psammitic schist samples from the Sanbagawa belt in the Kii Peninsula, central Shikoku, and eastern Kyushu. Detrital zircons that show oscillatory zoning structure under cathodoluminescence, a typical feature of igneous zircons, were separated from these samples, and the U-Pb age of each zircon was measured with LA-ICP-MS.

The results of the analysis clearly show that the 18 psammitic schist samples in the Sanbagawa belt were deposited in Late Cretaceous time or a little later. From the regional geologic structure mentioned above, the author proposes that the metamorphic rocks of the Sanbagawa belt, except for the eclogite unit and surrounding rocks occupying 10 % or less of the belt, have presumably been originated from the accretionary complex of the Cretaceous Shimanto belt. In other words, most of the protoliths of the Sanbagawa metamorphic belt had not been accreted to a continental or island-arc margin by the end of Early Cretaceous time, but were accreted from Late Cretaceous to earliest Paleogene times. In the present study, the metamorphic rocks of the Sanbagawa belt originated from the rocks of the Cretaceous Shimanto belt are called the Shimanto metamorphic rocks. The Shimanto metamorphic rocks are subdivided into three units as Lower, Middle, and Upper, from the zircon ages obtained in the present study and lithofacies. The Lower unit was formed in 75-70 Ma (Late Campanian-Maastrichtian) and are almost lacking in the zircons of 150-110 Ma. The Lower unit can be correlated with the Campanian-Maastrichtian unit of the Cretaceous Shimanto belt. The Middle unit is formed about 90 Ma (Turonian) and, is correlated with the Coniacian-Campanian unit of the Cretaceous Shimanto belt. Although chronological data from the Upper unit are scanty, the metamorphic rocks along the southern margin of the Sanbagawa belt contain lenses of calcareous schist yielding Late Triassic conodonts. Judging from the tectonostratigraphical position and lithofacies, the author proposes that this part of the Sanbagawa belt is occupied by metamorphic rocks originated from the Late Albian-Turonian units of the Cretaceous Shimanto belt.

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SGL042-05 Room:202 Time:May 23 17:30-17:45

MESOZOIC ZIRCON GRAINS FROM THE DEVONIAN YOSHIKI FORMATION, TAKAYAMA CITY, JAPAN

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Many studies had made clear the post-Carboniferous radiolarian biostratigraphy in the world, and radiolaria nowadays receives wide recognition as an important tool for revealing the Earth history. Whereas the biostratigraphy of pre-Devonian radiolaria has not been made clear yet. In order to confirm practical ages of Devonian radiolarians, we did radiometric dating of zircons in the radiolarian-bearing Yoshiki Formation, Takayama city, Japan. The Yoshiki Formation, composed mainly of alternating beds of tuffaceous sandstone and tuffaceous mudstone, felsic tuff, and alternating beds of sandstone and mudstone, yields very well-preserved radiolarian fossils. Although the formation was once believed to be Ordovician in age based on ostracods from a mudstone float beside outcrop (Igo et al., 1980), it is now considered to be Devonian as a result of recent radiolarian studie (Kurihara, 2004). Well-preserved radiolarians and zircon grains were collected from 21 tuffaceous mudstone and 30 tuff horizons. Identified radiolarian species are *Zadrappolus* (?) *nudus*, *Zadrappolus lunaris*, *Oriundogutta* (?) *varisoina*, *Futobari solidus*, *Oriundogutta* (?) *kingi*, *Futobari morishitai*, *Zadrappolus tenuis* and *Zadrappolus yoshikiens*. These radiolarians show Late Silurian to Early Devonian. On the other hand, U-Pb SHRIMP ages ranging from163 Ma to 2605 Ma were obtained form 58 zircon grains in this formation. This fact suggests that the Yoshiki Formation could be formed with detrital Devonian radiolarian fossils in Middle Jurassic. But the critical question is how were the so well-preserved radiolarians deposited into the formation as detrital grains. This point remains as a matter to be discussed further.

Keywords: DEVONIAN YOSHIKI FORMATION, MESOZOIC ZIRCON

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SGL042-P01 Room:Convention Hall Time:May 23 14:00-16:30

Stratigraphic study and sedimentary facies analysis of deep drill core in coastal area, Horonobe, Hokkaido

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Coastal area of Horonobe town in Hokkaido is a demonstration field to develop the evaluation methodology of a characteristic deep geological environment on the coastal region in Japan. Horonobe town locates in the Teshio plain where the basin subsidence is remarkable. Comprehensive geological structure of the Teshio plain has been understood by a large-scale geophysical exploration. The drilling site locates in the dune developed along the coast of the Teshio plain and the subsurface geology is composed alluvium (about 85m in thickness), Sarabetsu Formation (Pliocene to lower Pleistocene) and Yuchi Formation (Pliocene). However detail geology is not clarified because of any deep drilling has not been done at all in the coastal region of Horonobe town. We are carrying out the deep drilling survey to the depth of 1,004m in the site and the laboratory analysis of the core. From the result of analysis, it is cleared that geology is composed Sarabetsu Formation in which the cycle of gravel and sand rocks to mud repeats at a 30 to 50m cycle at thickness until 470m and Yuchi Formation in which sand or mud rocks at depth between 470m and 1,004m. In Sarabetsu Formation, sedimentary facies are classified several types such as shallow marine, lagoonal and fluvial deposits, and Upper part of Sarabetsu Formation is mainly composed of lagoonal and fluvial deposits. Yuchi Formation is mainly composed of shallow marine deposits in which repeated cycles of fining-upward succession are considered. From the cyclic succession of rock and the long-term change of sedimentary facies, it is suggested that geological environment of the site has been changed regionally from marine to fluvial environment with the sea level fluctuations.

Keywords: Coastal area, Deep all core drilling, Stratigraphy, Sedimentary facies, CNS elemental analysis

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SGL042-P02 Room:Convention Hall Time:May 23 14:00-16:30

Provenance study of the Jurassic clastic rocks in the Sizugawa area, South Kitakami Terrane

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The previous result of the provenance studies from conglomerate, sandstone and heavy minerals in the Jurassic sedimentary rocks in the South Kitakami Terrane revealed that the most of detritus was derived from granitic rocks and continental basement. However, sparse work has focused the provenance change during Jurassic time. Moreover, little work has addressed whole-rock chemical composition with trace elements related to provenance analysis.

The Jurassic sediments distributed in the Shizugawa area, South Kitakami Terrane, are divided into two groups; the Lower Jurassic Shizugawa Group and Middle-Upper Jurassic Hashiura Group. The purpose of this study is to examine the provenance change from the Lower to Upper Jurassic sediments in the Shizugawa area, on the basis of its major and trace elements compositions including rare earth elements (REE) by XRF and ICP-MS.

Major elements: Sandstones show SiO_2 contents between 61-76 wt% (average 69 wt%). Average of Al_2O_3 and K_2O/Na_2O ratios are 15 wt% and 0.7 respectively. Siltstones show SiO_2 contents between 59-70 wt% (average 65 wt%). Average of Al_2O_3 and K_2O/Na_2O ratios are 17 wt% and 1.3 respectively. Chemical composition of sandstones and siltstones closes to felsic igneous rocks, however Al_2O_3 is relatively enriched. Moreover, there is no significant trend become enriched in SiO_2 content in the Late Jurassic sediments that was suggested from the sandstones in the Soma and the Oshika areas, South Kitakami Terrene.

CIA index and A-CN-K diagram: The Chemical Index of Alteration (CIA : $CIA=Al_2O_3/(Al_2O_3+CaO*+Na_2O+K_2O)$ is established as a method of quantifying the degree of source rocks weathering (Nesbitt and Young, 1982, 1984). The Jurassic sediments in the Shizugawa area show CIA index from 51 to 70. The plots in A-CN-K diagram, which consists of Al_2O_3-$CaO+Na_2O$ and K_2O as end-members, suggest the protolith of the Jurassic sediments is correlated to felsic igneous rocks. Furthermore, it is also suggested that the Middle-Late Jurassic sediments were supplied from more felsic source rocks than the Early Jurassic.

REE pattern: REE patterns show enriched LREE and significant negative Eu anomalies, which is similar to the one of PAAS (post-Archean Australian shale: Taylor and McLennan,1985). Those patterns suggest that the provenance of the Jurassic sediments was mainly granite and continental basement. Middle Jurassic sandstones show significant trend enriched LREE. Because no siltstones show this trend, it is possible that the sandstones had different provenance from siltstones.

Trace elements: It is known that Th/Sc ratios reflect magmatic differentiation (Taylor and McLennan,1985; McLennan and Taylor,1991). The Middle and Upper Jurassic sediments have relatively high Th/Sc ratios (>1).

Geochemistry of the Jurassic sediments indicates the source rocks was granite and continental basement. The plots in A-CN-K diagram and trace elements imply the derivation from more felsic source during Middle to Late Jurassic time.

The obvious compositional change during Jurassic period has been reported from chemical composition and modal analysis of the sandstones in Japanese islands. The derivation from more felsic source rocks is recognized in the Middle and Late Jurassic time also in the Shizugawa area, which suggests the large provenance change in the eastern margin of the Asian continent.

Keywords: Jurassic, clastic rocks, provenance, chemical composition, rare earth element, trace element

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SGL042-P03 Room:Convention Hall Time:May 23 14:00-16:30

The chemical composition of the detrital heavy minerals in the Upper Cretaceous Kuji Group, northeast Japan

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The Kuji Group distributed in the northern part of the Kitakami Mountains is regarded as a Cretaceous deposit on forearc area. The sediments in the Kuji Group have remarkable characters with a large amount of lithic fragments, which reflects the derivation from various rock types. The provenance of the Kuji Group offers the information of the significant aspect of the Cretaceous arc system. Thus the provenance analysis of sandstones from the Kuji Group was carried out to clarify the detail of the hinterland on the basis of the chemical composition of detrital heavy minerals using by EDS. The detrital heavy minerals for analysis were prepared by heavy liquid separation. The number of grains analyzed is 36 grains of the garnet, 108 grains of the chromian spinel, and 127 grains of the tourmaline. Chemical analysis of detrital garnets reveals that the source area of the Kuji Group was composed of regional metamorphic rocks reaching greenschist to granulite facies condition and contact metamorphic rocks. The chemical composition of detrital tourmalines suggests the derivation from metasediment. Detrital chromian spinels is characterized by high TiO_2 ($>$ 0.5wt.%) implying the supply from island-arc basalts and intra-plate basalts. Small amount of chromian spinels with low TiO_2 ($<$0.5 wt%) are derived from ultramafic rocks. These chemical compositions of detrital heavy minerals suggest that the provenance of the Kuji Group was composed mainly of thermal metamorphic rocks, basic volcanic rocks and ultramafic rocks. The source rocks are found mainly in the North Kitakami Terrane and its contact metamorphic zone by Cretaceous granite, close to the Kuji Group. In respect to chromian spinels with low TiO_2 wt%, the source rocks are limited in ultramafic rocks of the Hayachine Terrane. During the late Cretaceous time, northeast Japan arc was situated along the eastern margin of the Asian continent where was suffered by active lateral fault (Xu et al., 1989). Thereby, it is likely that the wide variety of rocks were distributed with various erosional levels in the hinterland affected by such enhanced tectonism.

Keywords: detrital garnet, detrital chromian spinel, detrital tourmaline, provenance, Late Cretaceous, chemical composition

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SGL042-P04 Room:Convention Hall Time:May 23 14:00-16:30

Zircon U-Pb ages for granitic rocks from the cores drilled in the Kanto Plain

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We present the results of SHRIMP zircon U-Pb ages for basement granitic rocks of core samples drilled by AIST at Iwatsuki (1971) and southern Tsukuba (Kukizaki: 2006). For comparison, the zircon U-Pb age for Namee Granite exposed to the north of the Median Tectonic Line in the Shimonita area is also presented. The two core samples dated are 3509 m, the deepest part, from Iwatsuki and 809 m from Kukizaki, and are both mylonitized tonalite yielding cooling ages of 77-70Ma (Iwatsuki) and 66Ma (Kukizaki) reported. The results of zircon ages are:

IT3509 (Iwatsuki, tonalite) : 79.8 +/- 0.8Ma, 69.9 +/- 0.4Ma
KZ803 (Kukizaki, tonalite) : 86.3 +/- 0.7Ma
03122304 (Namee, granite) : 70.3 +/- 0.3Ma

These results suggest that the Iwatsuki and Kukizaki core samples are not correlative in age with the Abukuma and Tsukuba granitic rocks, but with the Ryoke granitic rocks, especially, with the older Ryoke granitic rocks. The Namee Granite is correlative with younger Ryoke granitic rocks, and is concordant with the lack of Ryoke regional metamorphic rocks around the granite body.

Keywords: Kanto Plain, Ryoke granitic rocks, SHRIMP zircon age

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SGL042-P05 Room:Convention Hall Time:May 23 14:00-16:30

Geology of the Takato-Hase district and the Ohsawa fault in the eastern Ryoke belt

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Jurassic accretionary complex and Ryoke metamorphic rocks are widely exposed in the easternmost Inner Zone of the Southwest Japan where strikes of bedding and schistosity planes are approximately N46E. The southern part of the Takato district is however an exceptional region where strikes of foliations are approximately N15E. A fault is suggested between the Takato district and its surrounding region. Hence, geological survey was carried out. The result is shown in Figure 1. The left map is of the southern part of the Takato district and the right map is of the Hase-Ichinose district located in the south of the Takato district.

Geology of the Takato district

Tomigata Granite is exposed in the western part of the surveyed region. The granitic pluton intruded into coarse-grained gneisses in northern regions and medium-grained gneisses in southern regions. Nevertheless, large blocks of low-grade metamorphic rocks which consist of biotite schists, biotite-cordierite schists and small amounts of meta-chert and calcareous rocks occur in the northern part of the pluton. The existence of a fault which is named as Ohsawa Fault (Figure 1) is suggested on the basis of the significant gap of metamorphic temperatures.

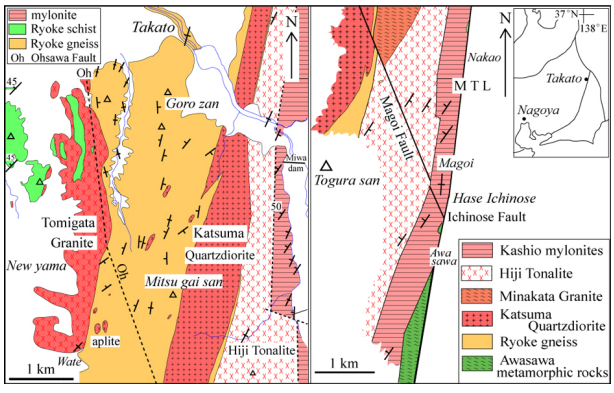
The location of the Ohsawa fault cannot be determined precisely in the Newyama area to the west of Mt. Mitsugaisan where psammitic gneisses are widely exposed. However, the existence of the Ohsawa fault is evident from the differences in strikes of foliations and grain-sizes of minerals. Quartz and plagioclase of psammitic gneisses to the west of the Ohsawa fault are small in grain sizes as compared with those of garnet-containing psammitic gneisses exposed near Mt. Mitsugaisan.

Geology of the Hase-Ichinose district

Hiji Tonalite and Katsuma Quartzdiorite are cut by the Magoi fault according to the geological maps published before. Actually, many faults are observed near the Magoi fault. Nevertheless, the strikes of foliations of Hiji Tonalite are approximately N40E in the Hase-Ichinose region. An exceptional site is found where the strikes of foliations are approximately N40W. Moreover, highly altered granitic rocks are exposed adjacent to the exceptional site. The exceptional site appears to be the Magoi fault. Altered granitic rocks which contain abundant oxychlorite are found at another locality to the southwest of the exceptional site. The trend of the Magoi fault is approximately N15W.

Summary

The Ohsawa fault was formed during the deformation of the Ryoke belt of the Takato district after the Ryoke regional metamorphism. The northern part of the fault is a boundary between Ryoke schists and gneisses. The Ryoke metamorphic rocks were intruded by Hiji Tonalite and Katsuma Quartzdiorite after the formation of the Ohsawa fault. Finally, the late Cretaceous granitic plutons were cut by the Magoi fault. The Magoi fault may be formed by the reactivation of the Ohsawa fault.



Keywords: eastern Ryoke belt, Mitsugaisan, Tomigata Granite, metamorphic rocks, Ohsawa Fault, Magoi Fault