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

SMP09-P01 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

東南極セール・ロンダーネ山地，原生代後期の閃長岩マグマ過程
Late Proterozoic syenite magmatism in the Sor Rondane Mountains, East Antarctica

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Syenites and related intrusive rocks are important to understand the process of collision zone magmatism in Dronning Maud Land (DML), East Antarctica, because DML is situated within the continental collision orogen between the West and East Gondwana. The Sor Rondane Mountains (SRM) is located in the eastern part of DML. According to the previous results, the timing of continental collision is regarded as the late Proterozoic (650 to 600 Ma) on SRM. Post-collisional intrusive rocks, granite stocks, a syenite complex, lamprophyres and dolerites, intrude the metamorphic rocks during the extensional stages in the region of SRM. In this paper, we address the geochronological and geochemical studies of the syenite complex and lamprophyres, and then discuss the timing of intrusion and the origin and formation of syenite magma.

The syenite complex occurring in the Lunckeryggen, the central part of the Sor Rondane Mountains, consists of a layered syenite, melanosyenite dikes and quartz syenite dikes. The syenite complex and the Lunckeryggen granite that is K-feldspar-rich alkaline granite are coeval intrusive rocks. The boundary between them is not clear and shows mingling structure. The lamprophyre locally intrudes the granite as a syn-plutonic dike. The U-Pb zircon dating used for the SHRIMP-II installed at NIPR gives ages of 559.4 +/- 1.6 Ma, 550.0 +/- 1.7 Ma, 548.8 +/- 3.4 Ma for the layered syenite, the granite and the melanosyenite dike, respectively. The recalculated Pb-Pb age of the lamprophyre shows 557.5 +/- 4.8 Ma. Considering the field relationships and the zircon SHRIMP dating, the syenite complex, granite and lamprophyre would, therefore, intrude into this suture zone during the same magmatic stage. The dolerite dikes also intrude the same stage as the previously described intrusive rocks because of their mode of occurrence although the dolerite dikes have not been dated yet.

The syenite complex and the lamprophyre have significant character with high-K (K2O/Na2O>3), high-LREE/HREE ratios and relatively enriched Sr-Nd isotopic compositions. The chondrite-normalized REE patterns of clinopyroxenes from the melanocratic part of layered syenite and lamprophyre show the concaved upward between LREE and MREE with HREE depletion. Considering petrography, mineralogy and geochemistry, the syenite complex has been derived from the lamprophyre magma, and fractional crystallization and accumulation played an important role of formation of the layered structure. The dolerite shows geochemical features similar to those of the within plate basalts in terms of some discrimination diagrams. Moreover, the Sr-Nd isotopic compositions of the dolerites are slightly depleted rather than the lamprophyres.

The lamprophyre possessing primitive compositions includes phenocrysts of Mg- and Cr-rich phlogopite. The P-T conditions of the lamprophyre magma are estimated by the biotite-liquid equilibrium relations. The calculated P-T conditions for the formation of lamprophyre magma are up to 1150 ?C and 1.6 GPa that is equivalent to 60 km depth that corresponds to the spinel lherzorite facies. On the other hand, the dolerite would be produced by the partial melting of a garnet lherzolite because of its geochemical signatures such as Ce/Sm and Sm/Yb ratios. The dolerite magma would, therefore, be derived from a source mantle deeper than that of the lamprophyre magma. The geochemical studies including Sr-Nd isotopic compositions reveal that the lamprophyre magma is derived from the enriched mantle; probably is formed by interaction between the dolerite magma derived from athenospher mantle and the enriched lithospheric mantle.

キーワード: 東南極, セール・ロンダーネ山地, 衝突帯, 閃長岩, ランプロファイアー, ドレライト
Keywords: East Antarctica, Sor Rondane Mountains, Collision zone, Syenite, Lamprophyre, Dolerite

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

SMP09-P02 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

Crustal assembly of the Masora and Antananarivo domains, central-eastern Madagascar
Crustal assembly of the Masora and Antananarivo domains, central-eastern Madagascar

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In reconstructions of the Gondwana supercontinent, correlations of Archean domains between Madagascar and India remain debated (e.g., Key et al., 2011; Ishwar-Kumar et al., 2013; Brandt et al., 2014; Collins et al., 2014; Plavsa et al., 2014; Rekha et al., 2014; Tucker et al., 2014). In this study, we aim to establish correlations among these Archean domains using whole-rock geochemistry and U-Pb zircon geochronology of meta-granitoids from the Masora and the Antananarivo domains, central-eastern Madagascar.

A meta-granitoid from the central part of Masora domain is dated at 3277 Ma and shows strongly fractionated REE pattern with high La/Yb ratio, which is a typical Archean tonalite-trondhjemite-granodiorite composition. A tonalitic gneiss from the southeastern part of the Antananarivo domain is dated at 2744 Ma and shows a positive Eu anomaly and relatively fractionated REE pattern with high La/Yb ratios. The major and trace element abundance of the tonalitic gneiss is consistent with the melt-depleted facies i.e., restitic rocks out of which some melt has been extracted (e.g., Barberton granitoids, south Africa; Moyen et al., 2007), different from that of the ca. 2500 Ma granitoid of the northwestern part of Antananarivo domain (e.g. Kroner et al., 2000; Macey et al., 2009). In addition, the major and trace element compositions of the ca. 760 Ma granitic gneisses are consistent with volcanic-arc origin for the protoliths.

Based on the geochemical and geochronological results, along with existing data, we identified three episodes of granitic magmatism at ca. 3300 Ma, 2700 Ma, and 2500 Ma in central-eastern Madagascar. Three diachronous magmatism events are consistent with those reported for the Dharwar Craton in India (Jayananda et al., 2013; Peucat et al., 2013), suggesting that the Archean Masora and Antananarivo domains in Madagascar were part of the Dharwar Craton at the end of Neoarchean (Tucker et al., 2011, 2014). The 700-800 Ma volcanic arc granitoids identified in central Madagascar (e.g. Handke et al., 1999; Kroner et al., 2000) have not been reported from the Dharwar Craton in India. Therefore, the subduction of the oceanic plate that led to the formation of these granitoids likely took place at the western margin of the Dharwar Craton, which included part of central-eastern Madagascar.

キーワード: マダガスカル, マスラ岩体, アンタナナリボ岩体, 太古代, 全岩化学組成, ウラン-鉛ジルコン年代
Keywords: Madagascar, Masora domain, Antananarivo domain, Archean, whole-rock geochemistry, U-Pb zircon geochronology

SMP09-P03 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

スリランカ・ハイランド岩体南西部の変成岩の LA-ICP-MS ジルコン U-Pb 年代
LA-ICP-MS Zircon U-Pb ages from metamorphic rocks in the southwestern part of Highland Complex, Sri Lanka

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Sri Lanka has been considered to locate inside the collision zone during amalgamation of the Gondwana supercontinent in Neoproterozoic to Early Cambrian (e.g. Meert, 2003). Therefore, Sri Lanka plays an important role to elucidate the process of amalgamation of the Gondwana supercontinent. Based on rock type, metamorphic grade and Nd model ages, the metamorphic rocks in Sri Lanka are subdivided into three major crustal units (Cooray, 1994; Kehelpannala, 1997; Kr?ner et al., 2003), which are Wanni Complex, Highland Complex (HC) and Vijayan Complex. The HC is composed of interlayered predominantly granulite-facies partly attaining to ultrahigh temperature (e.g. Osanai et al., 2006), granitic (charnockitic to enderbitic) gneiss and supraclastic metasediments with Nd model ages of ca. 2.0-3.0 Ga. However, Because of the shortage of zircon U-Pb isotope data by spot analysis and these geochronological data reported mostly from the central part of HC, the geochronological framework of HC is still unclear. In order to understand the geological process in HC, it's necessary to conduct the geological, petrological, geochemical and geochronological work by the unified method on the whole area of HC. This study provides the first report of LA-ICP-MS zircon U-Pb ages from metamorphic rocks in the southwestern part of HC.

We carried out LA-ICP-MS zircon U-Pb dating for ten samples corrected from five localities (2101: South of Horana, 2510: Southwest of Ratnapura, 2704: West of Morawaka, 2201: Southwest of Rakwana, 2803: Northwest of Embiliptiya). In 2101, zircons in Grt-Opx-Bt gneiss (2101D1) show 2560-670 Ma from inherited domain and 640-470 Ma from overgrown domain. Grt-Opx-Bt granulite (2101D2) has similar ages to 2101D1, which are 2500-710 Ma from inherited domain and 640-470 Ma from overgrown domain. In 2510, zircons in felsic Grt gneiss (2510A) show 1840 Ma from inherited domain and 630-490 Ma from overgrown domain. Although zircons in Two Px granulite (2510L) have inherited domain and overgrown domain, we could obtain the ages only from overgrown domain (620-490 Ma). In 2704, zircons in Spl bg. Grt-Sil-Crd gneiss (2704G) show 2040-730 Ma and 620-470 Ma from inherited domain and overgrown domain, respectively. In respect to Grt-Opx granulite (2704C), inherited domain and overgrown domain of zircons are recognized of ages of 620-530 Ma and 590-490 Ma, respectively. In 2201, Grt-Bt gneiss (2201B) is resulted in zircon U-Pb ages of 1860-1450 Ma from inherited domain and 620-530 Ma from overgrown domain, and zircons in Grt charnockite (2201A1) show the concordant age of ca. 1820 Ma from inherited domain and 610-510 Ma from overgrown domain. In 2803, zircons in felsic Grt-Hbl-Bt gneiss (2803B) show 1980-690 Ma from inherited domain and 640-550 Ma from overgrown domain, and those in Grt-Hbl-Bt gneiss (2803C) show two concordia ages of ca. 1890 and 1770 Ma from inherited domain and 580-520 Ma from overgrown domain.

Samples in 2101, 2510 and 2704 show broad age cluster of 550-510 Ma from both CL bright and dark overgrown domain, and Neoproterozoic ages (ca. 1000-700 Ma) with the small amount of Paleoproterozoic to Archean ages (ca. 2700-1600 Ma) from inherited domain. On the other hand, samples in 2201 and 2803 show mainly 590-580 Ma from CL dark overgrown domains and Mesoproterozoic to Paleoproterozoic ages (ca. 2000-1500 Ma) with the small amount of Neoproterozoic ages (ca. 700 Ma), which is the similar characteristics in the central part of HC. 2101, 2510 and 2704 are located at less quartzite or marble distributed area, while 2201 and 2803 are mostly located at quartzite or marble distributed area in the southwestern part of HC. On the basis of the relation between the internal texture of zircons and ages, the distribution of ages from inherited domain and overgrown domain of zircons, and constituent rocks, the southwestern part of HC can be divided into two areas such as Southwestern Group and Highland Group previously recognized.

Keywords: Gondwana, Sri Lanka, Highland Complex, LA-ICP-MS, zircon

SMP09-P04 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

南インド・チットラドゥルガ片岩帯に分布する後期太古代表成岩層序の再解釈
A revised tectonostratigraphy for Late Archean supracrustal rocks in the Chitradruga schist belt, Dharwar craton, India

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In order to understand late Archean tectonic and climatic systems prior to the great oxidation event, we studied volcano-sedimentary sequence of the Dharwar Supergroup, distributed in the Chitradurga Schist Belt, Western Dharwar craton. The Chitradurga schist belt consists of >3.0 Ga greenstones (Sargur Group) and overlying 2.9-2.6 Ga volcano-sedimentary sequence (Dharwar Supergroup), which are surrounded by 3.2~3.0 Ga TTG (tonalitic-trondhjemitic-granodioritic) gneiss (Chadwick et al., 2000; Jayananda et al., 2006). The Supergroup is classified into two major groups (lower Bababudan Group and upper Chitradurga Group). Preliminary studies on metamorphic conditions and geochronology of the Chitradurga Schist Belt have shown that this subdivision has to be reconsidered (Hokada et al., 2013). Therefore, we carried out a detailed lithostratigraphy, geochronology, metamorphism and tectonic evolution of the Chitradurga Schist Belt. Furthermore, it is important to compare the geological record with the other cratons for discussing any global events occurring in the late Archean. Our new field mapping and detrital zircon U-Pb dating allows us to reconstruct detailed lithostratigraphy of the Dharwar Supergroup. The lower unit consists of basal conglomerate, stromatolitic carbonate, silici-clastics with diamictite (Talya conglomerate), chert/BIFs and pillowed basalt in assending order, indicating that rift margin environment predominated at this time. The upper unit unconformably overlies the pillow lava, and consists of conglomerate/sandstone with ~2536 Ma detrital zircons, mafic lava, BIFs and silici-clastic sequence with mafic volcanics. The provenance analysis by detrital zircons allow us to divide the Dharwar Supergroup into the lower and upper groups. Especially, the maxima in the age distribution in the upper group (Hiriyur Formation) shows a peak at around 2.55 Ga, suggesting the source from the Eastern Dharwar Craton. Three metamorphic zones are identified in the Ingaldhal basalts. The metamorphic grade increases from lower greenschist facies to sub amphibolite facies. The boundaries between three metamorphic zones are subparallel to the bedding of interbedded BIF and tectonic contact between the lower group and upper group. On the other hand, the Hiriyur metabasalts are characterized by extensive carbonatization, whereas most samples from the lower group do not contain carbonate minerals. These differences in metamorphic grade and carbonatization of the greenstone indicate that the two groups of the Dhawrar Supergroup might preserve key information about amalgamation and/or breakup of the Dharwar protocontinent in the late Arcehan.

キーワード: 後期太古代, 南インド, 変成岩, 年代学, ジルコン, 超大陸
Keywords: Late Archean, Soth India, Metamorphism, Geochronology, zircon, Supercontinent

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

SMP09-P05 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

南インドダールワールクラトンチトラドルガシストベルトにおける太古代の縞状鉄鉱層を用いた地球化学的研究
Nd isotope geochemistry of Archaean BIFs in the Chitradurga Schist Belt, Dharwar Craton, Southern India

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Banded Iron Formations (BIFs) are successive layers of fine grade quartz and iron minerals which consist mainly of hematite, magnetite, and siderite. They are chemically precipitated in the sea and formed mostly in the Archaean and early Paleoproterozoic, and therefore record the information of the ancient oceans. It is believed that the iron source was supplied hydrothermal vents (Bekker et al., 2010), whereas silica was either sourced from hydrothermal vents (Steinhofel et al., 2010) or continental weathering (Hamade et al., 2003). In addition to the origin of BIF, the oxidation-reduction state of the seawater can be constrained by the characteristics of trace element, rare earth element and isotope geochemistry. We have studied the geochemical characteristics, in particular the Nd isotopes of BIFs in the Chitradurga schist belt, Dharwar craton, Southern India.

The Chitradurga Schist Belt belongs to the Dharwar Supergroup that overlies the basement Peninsular Gneiss (˜3.0 Ga) with enclaves of Surgur group (3.3˜3.1 Ga). The Dharwar Supergroup is subdivided into two groups, the Bababudan Group and the Chitradurga group. Hokada et al., (2013) suggested that the oldest depositional age of Bababudan Group and lower unit of Chitradurga group is around 3.14 Ga and 3.22?2.92 Ga and the youngest depositional age of upper unit of Chitradurga group is between 2.68 Ga and 2.63 Ga. In the lower Chitradurga unit is metamorphosed to the biotite-muscovite grade whereas the upper unit is chlorite-muscovite grade. Three major BIF layers occur in the Chitradurga Schist Belt, which belongs to the Bababudan Group, lower Chitradurga unit and upper Chitradurga unit. We compare the geochemical features of these three layers in this presentation.

The Chitradurga BIFs are mostly composed of quartz, magnetite and hematite and rarely contain siderite, pyrite, and carbonate minerals. Their compositions are almost SiO_2 and Fe_2O_3 and include few each other composition. The following data is the lower Chitradurga unit BIF. The majority BIFs in this unit show low REE contents, LREE<HREE and positive Eu and Y anomaly. These characteristics are similar to Archaean BIFs from South Africa, North America and Greenland except that they lack positive La and Y anomalies. The large positive Eu anomalies in BIFs attribute to high temperature hydrothermal fluid fluxes (Bau and Moller., 1993). Therefore the environment of deposition of BIFs was related to hydrothermal flux, probably relating to a rift environment. Sr isotopic ratios show large variations caused by post depositional alterations and/or metamorphism, whereas Nd isotope ratios have only small variations. Nd is an immobile element that represents primary values. Most of the BIFs have epsilon Nd values (estimated at 2.8Ga) considered as age is sedimentation age after (Hokada et al., 2013) between -2 to +2 and TDM model ages between 3.0Ga to 3.3Ga. The sedimentation ages and model ages are not equivalent. The epsilon Nd(2.8Ga) of depleted mantle is about +4, and metabasalts associated with the BIFs range are between -4 and +4. Within the same stratigraphic section their epsilon Nd(2.8Ga) values show both positive and negative signatures. Although the causes are not clear yet, it might be possibly due to the sedimentary environment affected of hydrothermal flux. The geochemical data of BIFs suggest that they were not affected by continental source and REY pattern probably show effect of high-T hydrothermal fluid fluxes in rift environment.

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Keywords: BIF, Archaean, Dharwar Craton

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

SMP09-P06 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

インド西ダルワールクラトンのチトラドゥルガ周辺に産する古始生代TTGおよび新始生代高K花崗岩の地球化学
Geochemistry of Paleoarchean TTGs and Neoarchean high-K granites around Chitradurga, western Dharwar Craton, India

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The western Dharwar Craton (WDC) mainly comprises TTG-type peninsular gneiss, greenstone belts, and high-potassium granites (e.g. Chadwick et al., 2000; Jayananda et al., 2013). The TTGs are widely distributed in the WDC as 3.4?3.2 Ga basement rock and occasionally contain more elder sediments and volcanics (i.e. the Sargur Group) (e.g., Peucat et al., 1993). The greenstone belts, named the Bababudan and the Chitradurga Group, unconformably overlies the TTGs as 2.9?2.6 Ga sedimentary covers (Hokada et al., 2013), consisting mainly of conglomerate/quartzite, BIFs, and mafic to felsic volcanics (e.g. Chadwick et al., 1981). The high-potassium granites crop out as several isolated intrusions in both the TTGs and the greenstone belts. The intrusive ages of the granites are mostly around 2.61 Ga (e.g. Jayananda et al., 2006). The aim of this paper is to make clear the petrographic and geochemical characteristics of the Paleoarchean TTGs and the Neoarchean high-potassium granites around Chitradurga in the WDC, southern India.

The TTGs are largely grouped into two types; K-feldspar (Kfs)-poor meta-trondhjemite and K-feldspar-rich meta-granite. The Kfs-poor meta-trondhjemite has petrographic and geochemical features of slab-derived TTGs. On the other hand, the Kfs-rich meta-granite contains abundant K-feldspar, a mineral phase that is not common in the TTGs. Additionally, the meta-granite shows different geochemical characteristics than that of TTGs. In particular, their Al2O3 and Sr contents are not enriched, and their K2O/Na2O ratios are higher, which look like continental type of TTGs. These features of rocks suggest that the Kfs-poor meta-trondhjemite are derived from oceanic crust melting, whereas the Kfs-rich meta-granite are derived from the re-melting of crustal materials. In Paleoarchean western Dharwar Craton, many slab-derived TTGs had intruded in to the crust. In addition, it is probable that the crustal recycling has already started.

The Neoarchean high-potassium granites around Chitradurga area are divided into three intrusions; Chitradurga granite, Hosdurga granite, and Jampalnaikankote granite (Jayananda et al., 2006). We revealed that they have different petrographic and geochemical features each other. The Chitradurga granite is a massive and coarse-grained. The Hosdurga granite is characterized by mylonitic foliation and consists of pinkish medium-grained rocks. The Jampalnaikankote granite is essentially including hornblende and is locally associated with gabbroic rocks. Chitradurga and Hosdurga granites can be geochemically classified into within-plate type granites, whereas the Jampalnaikankote granite is possibly of volcanic-arc origin. This suggests that the high-potassium granites are derived from different sources implying that the Neoarchean western Dharwar crust maybe composed of heterogeneous materials including volcanic arcs and matured continents. Based on detailed geochemical, we discuss the magmatic evolution and origin of the Paleo- to Neoarchean plutonic activity in the western Dharwar Craton.

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キーワード: TTG, 高 K 花崗岩, ダルワールクラトン, インド
Keywords: TTG, High-K granite, Dharwar Craton, India

SMP09-P07 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

ジルコン U-Pb 年代測定法に基づくネパールレッサーヒマラヤの現地性下部原生界の堆積年代と供給源に関する検討
Depositional ages and provenance of Paleoproterozoic sequence of Lesser Himalaya in Nepal based on U-Pb zircon dating

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Proterozoic Lesser Himalayan sediments (PLHS) is a thick sequence attaining 10,000 m deposited on a passive continental margin of the Supercontinent Columbia, which started its rifting at around 2.0 Ga. The PLHS could be correlated to the Chancheng Group on the North China craton and the Coronation Supergroup on the Slave craton in Northwestern Territory of Canada (Sakai et al., 2013), therefore the PLHS is important to understand tectonics and sedimentation in the rifting process of the supercontinent Columbia. In addition, it has also important key to solve the exhumation process of the Himalayan metamorphic belt, so called the Higher Himalayan Crystallines (HHC), which thrusts onto the PLHS and caused inverted metamorphism. However, age data of the PLHS are very limited except the lower group and granitic intrusives (augen gneiss) into the lowest Kuncha Formation. Then, we performed detrital zircon U-Pb dating of the three groups comprising the PLHS and granitic rocks intruded into the Kuncha. As the results, depositional age of the Lower Group was estimated from 1.9 to 1.75 Ga, and those of the Middle and the Upper Group are from 1.75 to 1.7 Ga and from 1.7 to about 1.6 Ga, respectively. Furthermore, we recognized two peaks of granitic activity at around 1.85 and 1.75 Ga. In this paper, we report the results of dating and discuss on the depositional age, provenance and tectonic meaning of unconformity between the groups.

The PLHS is divided into three groups: the Lower Group, the Middle Group, and the Upper Group. The Middle and Upper Group are separated by an unconformity. The uppermost part of the Kuncha Formation of the lowest unit of the PLHS yielded the youngest detrital zircon age of 1869 $\pm$ 24 Ma. The basal part and the uppermost part of the Naudanda Quartzite of the Lower Group yielded the youngest detrital zircon U-Pb ages of 1773 $\pm$ 55 Ma and 1755 $\pm$ 45 Ma, respectively. Then, the depositional age of the Lower Group is estimated to range 1870-1750 Ma. The youngest detrital zircon of the Nourpul Formation of the Middle Group yielded U-Pb age of 1650 $\pm$ 43 Ma. The youngest detrital zircon of the Benighat Slates of the lower part of the Upper Group yielded U-Pb age of 1586 $\pm$ 53 Ma. The Riri Limestone of the Upper Group yielded Pb-Pb age of 1683 $\pm$ 68 Ma (Watanabe, 2001MS). Then, the depositional age of the Middle Group is estimated to range 1750-1640 Ma, and that of the basal part of the Kerabari Formation at the uppermost stratigraphic unit of the PLHS is estimated to range 1640-1610 Ma. The Dunga Quartzite in the Robang Formation of the uppermost unit of the Nawakot Complex yielded the youngest detrital zircon age of 1800 $\pm$ 63 Ma, which is assigned to the age of the Lower Group. Thus, it is no doubt that this overturning of age was caused by thurusting of the Kuncha nappe over the Malekhu Limestone of the Upper Group.

A mylonitic granite intruded into the sediments of the MCT zone, which is the uppermost part of the Kuncha nappe, was dated as 1769 $\pm$ 15 Ma, and an augen gneiss intruded into the basal part of the MCT zone was dated as 1730.4 $\pm$ 9.7 Ma. They show younger ages than previously reported ages of granites intruding into the Kuncha Formation (1.9-1.8 Ga). It suggests that igneous activity occurred intermittently within the sedimentary basin of the PLHS. Age distribution histogram of detrital zircons from the Lower Group commonly have two peaks at around ˜1850 Ma and ˜2450 Ma. On the other hand, age distributions of detrital zircons from the Upper and Middle Group have an unique peak around ˜1750 Ma. This indicates that tectonic event occurred in between the Lower and Middle Group, and caused a change of the provenance of detritus.
Keywords: Lesser Himalaya

SMP09-P08 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

Geochronology, geochemistry and petrology of Bashisuogong intrusions: Implications for magmatic evolution of Tarim LIP

Geochronology, geochemistry and petrology of Bashisuogong intrusions: Implications for magmatic evolution of Tarim LIP

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The alkali granitic intrusions are exposed in the Bashisuogong region, which is located in the northwest margin of Tarim Block, NW China. Recent research suggested that the coeval basalt lavas, mafic-ultramafic intrusions, as well as the mafic dikes and syenitic and granitic intrusions in Tarim, composed an Early Permian Tarim large igneous province (Tarim LIP).

Zircon U-Pb dating, whole-rock major and trace element and isotopic data are presented for the granitic intrusions in Bashisuogong region. Compared to the previous study on the coeval mafic-ultramafic and granitic intrusions in Piqiang and Halajun area of Tarim Block, the new SHIRMP U-Pb age for Bashisuogong intrusion reveals that all the igneous rocks in the northweat region of Tarim Block are coeval (ca. 275 Ma). Geochemically, the granitic intrusions show high contents of SiO_2, K_2O, total alkalis, HFSE and Ga/Al, $FeO_t/(FeO_t + MgO)$ and Nb/Y ratios, which favor an A-type affinity for the granitic intrusions.

These geochronology and geochemistry data of Bashisuogong intrusions will be integrated with published data for the other intrusive rocks within Tarim Block to provide a more complete interpretation of the magmatic source(s) and evolutionary history of this important intrusion of the Tarim LIP and with implications for the Tarim LIP as a whole.

キーワード: Tarim LIP, magmatic evolution, granitic intrusion, geochronology, geochemistry
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Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SMP09-P09 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

Tectono-metamorphic evolution of the upper sequence of Hidaka Metamorphic rocks in Satsunai-gawa River, Hokkaido, Japan

Tectono-metamorphic evolution of the upper sequence of Hidaka Metamorphic rocks in Satsunai-gawa River, Hokkaido, Japan

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Hidaka Metamorphic Belt (HMB) is one of the youngest *HT-LP* metamorphic belts, that provide an opportunity to investigate the low-grade metamorphism in the upper to lower cross-section of magmatic arc. The previous studies have mainly considered the lower sequence of metamorphic rocks from the various viewpoints of magmatism, metamorphism and deformation (e.g. Osanai et al. 1991; Toyoshima et al. 1994). Most of such studies on metamorphic and structural evolution of HMB are based on the data from high-grade metamorphic rocks and associated igneous rocks. Here, we propose new constraints on the tectono-metamorphic evolution of upper sequence of Hidaka Metamorphic rocks based on a comprehensive field mapping and structural analysis of upper sequence of HMB in the upper reach of Satsunai-gawa River, Hokkaido, Japan combined with Raman Spectra of Carbonaceous Material (RSCM) thermometry and Illite Crystallinity.

The study area is mainly grouped into two metamorphic zones, which are composed of muscovite-chlorite (Zone I), muscovite-biotite+/-chlorite assemblages and muscovite-biotite (Zone II), respectively. The muscovite-chlorite metasediments are metamorphosed at the peak condition of 200-400 degree C based on the RSCM thermometry and IC data, and the muscovite-biotite metasediments, schist and gneiss are metamorphosed at about 400 to 650 degree C. Peak metamorphic pattern and mineral assemblages are progressively changed from the eastern to the western area, suggesting the geothermal gradient of 39-47 degree C / km (R2 = 0.8 to 0.9). In addition to the understanding of thermal gradients, we also attempted a detailed structural analysis of metasedimentary rocks based on the data of Koyasu et al. (2007). In the study area, the structural evolution can be mainly grouped into three tectonic events; Stage I to Stage III. Stage I is characterized by the tectonic thickening of fore arc sediments (D0 stage), shearing (D1 stage), large-scale folding (B2) and sinistral and normal sense of shear (D2 stage), and layer-normal shortening of D3 quartz veins and metamorphic rocks (D4 stage) during prograde metamorphism. After these deformations, S-type tonalites intruded in these metamorphic rocks during stage II. The biotite-muscovite gneisses are mainly deformed by dextral and normal sense of shear before (D5 stage) and after the intrusion of D6 tonalites (D7 stage). Some metasedimentary layers were deformed by the sinistral and normal sense of shear (D8 stage) during retrograde metamorphism. Finally, brittle deformations are observed within the metasediments and tonalites during stage III. That D9 deformation involved the N-S to NW-SE shearing and cut the regional schistosities, B2 folding and peak metamorphic pattern (M1 thermal gradient).

At the B2 axial area, the S1 schistosity is cut by the S2 schistosity at high angle, and the syn- or post-D2 cordierite porphyroblasts are observed along to the S2 schistosity. In addition, the peak metamorphic pattern based on RSCM thermometry shows slightly oblique to the regional S1 schistosity, D0 bedding plane, and map-scale folding. These data suggest that the peak metamorphic event (M1) involved between B2 folding and the intrusion of the tonalities, and these events in the upper sequence contradict with the tectonic, metamorphic and geochronological evolutions of lower sequence. Detailed relationship between peak metamorphism and tectonic evolution of upper sequence of HMB is going to discuss in poster session.

Reference: Osanai et al., 1991. J. Metamorph. Geol. 9, 111-124. Toyoshima et al., 1994. Isl. Arc 3, 182-198. Koyasu et al. 2007. JPGU meeting, abstract.

Keywords: RSCM thermometry, Illite crystallinity, graphite, Structural evolution

SMP09-P10 会場:コンベンションホール 時間:5 月 27 日 18:15-19:30

ジルコン U-Pb 年代に基づく阿武隈深成岩体形成史
Spatial U-Pb age distributions of plutonic rocks in the central Abukuma Plateau, northeastern Japan Arc

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Intrusive ages of the Abukuma plutonic rocks, a major Cretaceous granitic suite in the Japan Arc, were determined using zircon U?Pb age method. The U?Pb ages of the ‘Hbl-Bt granitoids’ distributed in the western to central part of the Abukuma Plateau were 113-99 Ma, whereas five ‘east leucocratic granitoids’ intruded within a short time range of 112-106 Ma. The U?Pb ages of a gabbro from the Mt. Katasone and of the ‘western leucocratic granitoid’ were115.2 $\pm$ 1.1 Ma and 96.7 $\pm$ 1.0 Ma, respectively. The above age distribution combined with geochemical results suggests that. Based on these zircon U?Pb age, significant difference of the intrusive age between ‘east-’ and ‘west leucocratic granitoids’ was indicated.

キーワード: 阿武隈, 花崗岩, ジルコン, U-Pb, LA-ICP-MS
Keywords: Abukuma, granite, zircon, U-Pb, LA-ICP-MS