Origin of felsic middle crust: Evidence from experimental study for Cretaceous I-type granodiorite in Kyushu, SW Japan

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The Asian continent was formed by continental collision during the Late Paleozoic. Japanese island was situated along the active continental margin before opening into the Sea of Japan. The matured continental crust is generally made of mafic lower crust and felsic middle to upper crust in terms of seismic profiles. Here, we report the formation of felsic middle crust along the active continental margin during the Cretaceous, the eastern end of Asian continent. The northern part of Kyushu is underlain by the Cretaceous granitoids. The granitoids consist mainly of hornblende granodiorite with small amounts of coeval diorites, and include cumulous gabbros as blocks. The granodiorite contains magmatic epidote and its emplacement depth is of the middle crust. The granodiorite and diorite make different chemical trends on some variation diagrams. The initial Sr-Nd isotopic compositions, however, resemble each other among three lithologies. The cumulous gabbro contains euhedral hornblende and clinopyroxene with trace amounts of plagioclase. The hornblende could be equilibrium with the granodiorite melt in terms of trace element compositions. Considering geological and geochemical signatures, the granodiorite magma can be produced by partial melting of the cumulous gabbro. To verify the petrogenesis of granodiorite magma, we performed melting experiment by the piston-cylinder apparatus using the cumulous gabbro as a starting material with 900 degree and 800 MPa. The chemical composition of synthetic glasses resembles that of the high-silica samples of granodiorite. The mineral compositions of run products are the same as cumulous gabbro. Results of this experiment can duplicate the formation of high-silica granodiorite magma. The granodiorite magma was chemically modified by mixing with coeval diorite. The magma ascended through the crust and was emplacement at the middle crust. It is an essential process to form the felsic middle crust underneath the volcanic arc setting.

Keywords: Felsic middle crust, Partial melting, Melting experiment

Trace element partitioning during partial melting in main zone of the Hidaka metamorphic belt

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The Hidaka metamorphic belt which represents a titled crustal section of a magmatic arc of tertiary age, is situated in the central part of Hokkaido, northern Japan. Opx amphibolite which were metamorphosed under granulite-facies conditions, are distributed in this area, and has been reported orthopyroxene bearing leucosome by dehydration melting of hornblende (Osanai et al., 2006). In recent years, new partition coefficient be reported from migmatite in lower crustal condition (e. g. Nehring et al., 2010). This study focus on Opx amphibolite involving Opx leucosome, and discuss about trace element partitioning at lower crustal P-T condition.

Opx amphibolite consist of orthopyroxene ($En_{0.58-0.62}$), brown-hornblende, plagioclase, quartz and ilmenite. Plagioclase rim show high-anorthite (An) content (An_{70-85}) against low-An core (An_{45-69}). Opx leucosome contain euhedral orthopyroxene ($En_{0.54-0.64}$) which be thought as new product by following incongruent melting; Hbl+Qz→Opx+melt (Osanai et al., 2006). Opx leucosome lacks K-feldsper, and consist of orthopyroxene, plagioclase (An_{28-43}), quartz, ilmenite and apatite.

We analyzed bulk and mineral composition including trace elements (Rb, Sr, Y, REEs and Hf). Kawanami et al. (2006) report bulk chemical composition of low-grade amphibolite which show N-MORB characteristics. REE pattern of Opx amphibolite show same or higher REE than N-MORB, and have a negative Eu anomaly. Opx leucosome show 52.8-64.4 [wt. %] of SiO_2, and LREE-rich and HREE-deplete REE pattern having negative to positive Eu anomaly. REE pattern difference remarkably depend on modal amount of apatite.

We estimated melt compositions using simple calculation that remove orthopyroxene composition from bulk chemical composition, and calculate trace element ratio between orthopyroxene and melt. REE ratio between orthopyroxene and melt, become less than 1, and show LREE-deplete and HREE-enrich (0.6-6.1) pattern. This pattern almost same as previous partition coefficient (e. g. Green et al., 2000). And, we also find characteristics that minerals/plagioclase REE ratio in Opx leucosome become almost same between each samples collected from different place in main zone of the Hidaka metamorphic belt. In this presentation, we discuss more detail about melt composition, equilibrium and meanings of mineral/melt and mineral/mineral trace element ratio.

Keywords: Hidaka metamorphic belt, Japan, trace element, partitioning, LA-ICP-MS

Role of Basaltic Magma in the Evolution of Continental Crust: Formation process of Nikanbetsu Gabbro Complex in the Hidaka Metamorphic Belt

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The net growth of continental crust and the development of layered structure occur owing to the addition of basaltic magma and heat from the mantle in arc environment. The purpose of this study is to clarify the role of basaltic rocks, now frozen as gabbroic bodies in an exposed section of arc crust as metamorphic belt, in the heat and mass transportation processes through the crust. We have chosen the Hidaka metamorphic belt, which is a high-temperature medium-pressure type and was uplifted by collision of two island arcs. It is believed that the metamorphic belt represent a cross section of the arc crust exposed continuously from the upper crust (eastern side), through the lower crust, to the upper mantle (western side) (Komatsu et al., 1986). We particularly focus on the southern area, where several peridotite bodies are associated with large gabbroic-tonalite bodies, one of which is the Nikanbetsu gabbro complex, our study target. The gabbro complex consists of various lithologies such as troctolite, olivine gabbro, gabbronorite, and quartz diorite, all of which shows diverse variation in grain sizes and complex contacting relationships in the field. There is a systematic lithological distribution; less fractionated rocks such as olivine gabbro are distributed in the peripheral (northeastern) part, the more fractionated quartz diorite in the central part of the complex, and moderately fractionated gabbronorites in betweem. The complex can be regarded as a zoned pluton, which is similar to the Opirarukaomappu gabbro/tonalite complex (Honma, 1997) located to the northeast of the Nikanbetsu gabbro complex.
The An # = Ca / (Ca + Na + K) of plagioclase, and Mg # = Mg / (Mg + Fe) of clinopyroxene and orthopyroxene, decrease continuously from olivine gabbro to quartz diorite. By investigating the whole rock chemical composition focusing on fine grained rocks, which better reflect the melt composition, it was found that the less fractionated magmas, such as olivine gabbro, are classified as the tholeiite series, whereas more fractionated ones, such as quartz diorite and some gabbronorites, are classified as calc-alkaline series. This contrast is also evident in their rare earth element (REE) concentration patterns.The former shows a REE pattern depleted in LREE, whereas the latter shows a pattern enriched in LREE. Any crystal fractionation models cannot reproduce the latter from the former as a parental magma. It is concluded that there were at least two contrasting parent magmas: one belonging to the tholeiite series and the other to the calc-alkaline series. It can be inferred from its trace element pattern that the parent magma of olivine gabbro formed by adiabatic decompressional melting of the Middle Ocean Ridge Basalt (MORB) source mantle. We propose a scenario that the heat released by the crystallization of this magma elevating the temperature of the lower part of the Hidaka crust to form the parent magma of quartz diorite belonging to the calc-alkaline series by partial melting. The Nikanbetsu gabbro complex gives us an excellent chance to scrutinize processes of heat and material transportation, which takes place deep in the crust and is usually not accessible.

Geochemical and Geochronological records from South section of the Kongling Complex: Implications for the complex growth and reworking process of the Yangtze Craton nucleus

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The Archean Kongling Complex is an ideal target to investigate the Precambrian accretion and evolution process of the Yangtze Craton, for it experienced multiple episodes of growth and reworking events. This study aims to provide systematical understanding of the formation and evolution process of the South section of the Kongling Complex (SKC) and contrasting geochemical and geochronological records from both sections of the Complex (SKC and NKC). Basement rocks and supracrustal rocks were picked from the SKC, in where the geological process was unknown during 2.9 Ga to 1.0 Ga. Zircons from the biotite plagioclase gneiss, biotite two-feldspar gneiss, biotite amphibolite plagioclase gneiss, plagioclase-amphibolite suggest that the basement rocks of the SKC involved with Archean 2.9 Ga and 2.7–2.6 Ga growth and reworking events, followed by latter ~2.4 Ga and ~1.7 Ga geological events. The major and trace elements of the SKC metasedimentary rocks imply their protolith are Archean Kongling TTG and amphibolite. The zircon U-Pb-Hf data from the SKC are similar with those in the NKC during 2.9–2.6 Ga and 1.8–1.7 Ga, indicating both the SKC and the NKC have Archean basement rocks and suffered from the Paleoproterozoic extension event. However, the SKC is not the miniature of the NKC for it had no response to the Paleoproterozoic ~2.0 Ga collisional event. Compiled with all available data of the formation and reworking ages of entire Kongling Complex, the NKC could be further divided as west NKC, middle NKC and east NKC while the SKC is as same as the west NKC. Based on our new analyzed data and comparative study of the SKC and NKC, all previous files were put into order to understand the formation and evolution process of the Craton nucleus.

Keywords: Yangtze Craton, Kongling Complex, Craton nucleus, Formation and evolution

Geological and geochemical characteristics of UHT metamorphic rocks from the Amundsen Bay region in the Napier Complex, East Antarctica

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The Tonagh and Bunt Islands locate in the southern-end of Amundsen Bay, northern Enderby Land, which belongs to the central Napier Complex and shows a part of the highest-grade metamorphic region in the Napier Complex. The islands are mostly underlain by various kinds of ultrahigh-temperature (UHT) metamorphic rocks. UHT-metamorphic rocks from the Tonagh Island are subdivided into five lithologic units (Units I to V) owing to their lithologies and geological structures from north to south bounded by thrust-shear zones, accompanying with remarkable anhydrous mylonite and later pseudotachylite-cataclasite.

A geological perspective of the metamorphic rocks from the Tonagh and Bunt Islands is generally classified into 8 types on the regional map scale such as (1) Opx-bearing quartzofeldspathic charnockitic gneiss, (2) Grt-bearing quartzofeldspathic gneiss, (3) Opx-Cpx-bearing mafic granulite, (4) Grt-Opx gneiss and granulite, (5) Mt-Qz gneiss, (6) metamorphosed ultramafic rocks, (7) layered gneiss 1 (composed mainly of mafic gneiss and Opx-bearing quartzofeldspathic gneiss), (8) layered gneiss 2 (composed mainly of mafic gneiss and Grt-bearing quartzofeldspathic gneiss) with subordinate meta-impure quartzite, Spr-bearing aluminous restitic granulite, and calc-silicate granulite. Types-(1) and -(2) are main constituents of the Tonagh Island and Osm- and Spr-bearing aluminous granulite is characteristically found in Bunt Island.

Especially the Unit I of the Tonagh Island has a peculiarity of predominance of layered gneisses showing thin alternation (centimeter to several meters in thickness) of various kinds of UHT metamorphic rocks (mafic, intermediate and felsic in bulk chemical compositions) and metamorphosed ultramafic rocks (pyroxenite and lherzolite). All these metamorphic rocks show a simple variation trend from the komatiite field to the rhyolite field and have bimodal chemical clusters of ultramafic-mafic and highly quartzofeldspathic in compositions. Spr- and Osm-bearing granulite as a typical UHT metamorphic rock have silica-undersaturated and aluminous chemical compositions, which would have formed as the restite and/or metasomatic reaction product under the UHT condition. The Spr- and Qz-bearing granulites have also derived from partial melting of metamorphic rocks having pelitic composition. In any case, most of the metamorphic rocks from the Tonagh and Bunt Islands got the anhydrous mineral assemblages excepting later retrograde hydration with forming micas and amphiboles during the highest-grade metamorphism of 2480-2550 Ma.

Keywords: Enderby Land, Napier Complex, Tonagh Island, Bunt Island, UHT metamorphic rocks

Neoarchean, Paleoproterozoic, and Neoproterozoic arc magmatisms in the Lützow-Holm Complex, East Antarctica: implications for multiple collisional events during Gondwana amalgamation

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The Lützow–Holm Complex (LHC) of East Antarctica, which contains various amphibolite- to granulite-facies rocks with the latest Neoproterozoic peak metamorphic ages (600-550 Ma), forms a part of the crustal segment of the East African–Antarctic Orogen. Similar high-grade metamorphic rocks exposes in adjacent Gondwana fragments such as Sri Lanka, Southern India, and Madagascar. Here, we present new petrological, geochemical, and zircon U–Pb data for meta-igneous rocks from the LHC, as well as our published data, and evaluate the presence of several magmatic arcs that accreted and collided each other before the final collision and formation of Gondwana Supercontinent.
The oldest crustal fragment in the LHC occurs in the southwestern part of the complex such as ca. 2.5 Ga charnockite from Vesleknausen and Sudare-iwa (Tsunogae et al., 2014, 2016). Geochemical signatures of the rocks suggest the protoliths of the charnockite was formed through Neoarchean arc magmatism. Zircon Lu-Hf data of the Neoarchean charnockites indicate that the protolith magma was sourced from Paleo- to Neoarchean juvenile components mixed with reworked ancient crustal materials.
Neoproterozoic arc magmatic rocks derived from juvenile sources have been reported from several localities throughout the LHC such as Hutatu-iwa, Innhovde, Tama Point, Kasumi-iwa, and Langhovde (Tsunogae et al., 2015, 2016). Metagabbro from Akarui Point shows zircon U-Pb age of ca. 850 Ma with minor xenocrystic zircons of 1026-882 Ma (Kazami et al., 2016), suggest crustal reworking.
Paleoproterozoic magmatic ages of ca. 1.8 Ga have been reported from Austhovde, Telen, Skallevikshalsen, and Skallen, which corresponds to the highest-grade portion of the complex. Geochemical signatures of the ca. 1.8 Ga metaigneous rocks also suggest arc magmatism for the formation of the protolith. The ca. 1.8 Ga magmatic terrane occurs as a belt between the ca. 2.5 Ga microcontinent and ca. 1.0 Ga magmatic arc, suggesting that the LHC was formed by a series of arc-continent collisional during the latest Neoproterozoic.

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Keywords: arc magmatism, Gondwana, zircon geochronology

High-pressure granulites in North China Craton and its implications for the Columbia supercontinent evolution

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High-pressure (HP) granulites are widely distributed within the Paleoproterozoic Jiao-Liao-Ji Orogenic Belt (JLJB), Trans-North China Orogen (TNCO), and Khondalite Belt (KB) of the North China Craton (NCC). HP granulites in the SW segment of the JLJB in the eastern part of the NCC occur as irregular lenses or dike swarms in the Paleoproterozoic metamorphic complex, which extend from NE Yantai to SW Anqiu about 300 km in length. Petrographic examination has revealed that HP granulites record a peak HP granulite-facies assemblage (M_1) of Grt + Cpx + Pl + Qtz, and a subsequent decompression assemblage (M_2) of Opx + Cpx + Pl ±Amp ±Fe–Ti oxides, which formed at 755–866 ˚C and 1.28–1.44 GPa, and 780–840 ˚C and 0.5–0.8 GPa, respectively. U–Pb dating of distinct zircon domains revealed the protolith ages of 2.2-2.0 Ga, the timing of the peak HP granulite-facies metamorphism at 1.95-1.9 Ga, and the subsequent retrogression at 1.86-1.84 Ga, respectively. Comprehensive petrographic and geochronological investigations of the HP granulites defined a clockwise P-T-t path involving a near-isothermal decompression and near-isobaric cooling process. The TNCO is a nearly north-south-trending ~1200 km long and 100-300 km wide belt in the centre part of the NCC. HP granulites mainly distribute in Hengshan, Huai’ an, Xuanhua and Chengde areas, which record a similar metamorphic history characterized by near-isothermal decompressional clockwise P–T paths with peak metamorphic conditions of 800-870˚C and 1.05-1.6 GPa. Geochronological data of the HP granulites in the TNCO reveal two group metamorphic ages of 1.95-1.92 Ga and ~1.85 Ga, representing the timing of peak metamorphism and subsequent retrogression, respectively. HP granulites from the KB in the western part of the NCC occur as irregular lenses within granitic gneisses and Khondalite series, which outcropped from Xiaoshihao to Baiyuanhua about 100 km in length. The HP mafic granulites preserve a typical HP granulite-facies assemblage of Grt + Cpx + Pl + Amp ±Qtz ±Fe–Ti oxides. Pseudosection modeling and conventional thermobarometers constrain the peak HP granulite facies metamorphic conditions of 760-845 ˚C and 1.25-1.4 GPa, and a subsequent retrogression of 825-860 ˚C and 0.72-0.8 GPa with a typical clockwise P-T path. In-situ U–Pb dating of zircons show the protolith ages of 2.1-2.0 Ga, peak HP granulite-facies metamorphism at 1.96-1.94 Ga, and subsequent retrogression at 1.86-1.82 Ga, respectively.

The consistency of the petrography, clockwise P-T-t path and metamorphic timing for the HP granulites of the JLJB, TNCO and KB within the NCC indicate that the micro-blocks occurred continent-continent (or arc) collision at the Paleoproterozoic (1.96-1.9 Ga), resulting in the final amalgamation of the NCC. This newly summarized result has an important significance for the studies in-depth of the global Columbia supercontinent evolution.

Keywords: HP granulite, P-T-t path, Paleoproterozoic orogenic belts, North China Craton

Sri Lanka - Correlation with N. Mozambique at the heart of Gondwana: North and South.

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Grantham et al., (2008) positioned Sri Lanka adjacent to N. Mozambique, prior to Gondwana breakup, in a position requiring *ca* 90° clockwise rotation (Reeves 2004) with the result that the Vijayan Complex is correlatable with the Nampula Terrane (NT) of N. Mozambique. The Lurio Belt, bounding the Nampula Terrane to the N. was correlated with the shear zone separating the Vijayan and Highland Complexes. Exposures in N. Mozambique are poor, hampering studies of structural kinematics within the Lurio Belt.

Lithologies and structures in the Vijayan Complex (VC) exposed in quarries and along the S. coast of Sri Lanka show that the rocks consist dominantly of migmatitic tonalite and granitic (mostly porphyroclastic augen) gneisses with strong, mostly shallow dipping, planar fabrics. At one quarry, banded migmatitic tonalitic gneisses show strong folding and shearing. The folds and shears typically show a top-to-the east geometry. Lineations plunge shallowly N and S. The data suggest a transpressional deformation setting.

Comparison of lithologies and structures from the VC with data from the Nampula Terrane (NT) of N. Mozambique show that the tonalitic and granitic gneisses are similar to the Mocuba and Culicui Suites of the NT. The geometry of structures in the VC, rotated *ca* 90°, consistent with its position in Gondwana, are comparable to structures from northern Mozambique from the NT. Plunges of lineations in the NT in the Meconte-Monapo areas cover a broad arc of westerly to NE with three crude groups of WNW, NW to NNE and NE respectively. The WNW direction, is largely seen in the N of the Meconte-Monapo sheet, approaching the Lurio Belt. Its orientation is similar to the rotated orientation of lineations from S. Sri Lanka. The Meconte-Monapo sheet lineations plunge dominantly NW to NNE over most of the area but rotate sinistrally toward the Lurio Belt in the north. Broad fold patterns show two phases with ENE oriented fold axial traces and cross cutting NNW fold axial traces. Planar fabrics in Mozambique dip dominantly SE. Limited planar fabric data from Sri Lanka, rotated through 90° dip to the S.

Comparison of limited radiogenic isotope data (Sr,Nd) from the NT with published data from the VC show that they are similar. Comparison of published zircon crystallisation and metamorphic ages show peaks of ~1000-1100Ma and ~550Ma respectively. Available structural, isotopic and geochronological data consequently support correlations between the Vijayan Complex of Sri Lanka with the Nampula Complex of northern Mozambique and its extensions via the Barue Complex, N. Mozambique to the Maud Belt of western Dronning Maud Land, Antartcica

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Keywords: Sri Lanka, Mozambique, Gondwana

Sr isotope chemostratigraphy of metacarbonate rocks from East Gondwana; Implications for depositional environments and correlations

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Sri Lanka, southern India, Madagascar, Mozambique and the Dronning Maud Land in East Antarctica forms an integral part of the Latest Proterozoic to Early Cambrian collision zone in the East African-Antractic Orogen (EAAO). The Mozambique Ocean is supposed to have existed between East- and West-Gondwana, before its final amalgamation to form a single Gondwana supercontinent, where carbonate depositions by chemical precipitation was prominent. Carbonate rocks can be ideal for considering the geochemical information of the paleo-ocean that separated continents and cratons that existed prior to the Gondwana amalgamation.

Taking advantage of the characteristics of metacarbonate rocks to understand the depositional history of oceanic basins, we compile data from several terrains in the EAAO belt and attempt to correlate between the terrains. Pure carbonate samples that were least influenced by alteration (that consist of calcite/ dolomite mineral or only with minor amounts of calc-silicate minerals) were selected for this purpose. Based on thin section observation, oxygen and carbon isotopic composition and trace and rare earth element patterns we selected the purest samples for Sr isotope analysis. The $\delta^{18}O$ values of meta-carbonate rocks above 20 ‰and those with flat REE patterns were the best candidates for Sr isotope analysis.

The Sr isotopic compositions was compared with standard late Proterozoic Sr isotope chemostratigraphic curve, which suggest apparent depositional ages between 900 Ma to 660 Ma. Comparable Neoproterozoic sedimentation histories were obtained from the Highland Complex, Sri Lanaka, Madurai Block, southern India, and Dronning Maud Land, East Antarctica. In this presentation we discuss the possible correlation between different blocks within the East Gondwana ensemble.

Keywords: Sr isotopes, Gondwana, Chemostratigraphy

Petrological, geochemical and geochronological insights to the stature of Mercara Suture Zone in the Southern Peninsular India and its role in Gondwana

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Southern India was the leading vertex of India as it collided with the other Gondwana continents in Ediacaran-Cambrian times. The south Indian shield which preserves early formed crust (prior to 2500 Ma) has been divided into the Dharvar Craton (DC) and the Southern Granulite Terrain (SGT) by Fermor (1936), is a transition between the charnockitic and non-charnockitic terrains (Fig. 1a). The Mercara Shear Zone is sandwiched between the Western Dharwar craton and the Coorg block in the northern periphery of the SGT (Fig. 1b). The shear zone is marked by steep gravity gradients reflecting the presence of under plated high-density material, along with the electrical anomalies suggestive for vertical conductive structure extending from the lower crust into the upper mantle coinciding with this geologically marked transition zone.

Previous studies correlated the trace of this zone to Mesoproterozoic Rodinian suture, in which the Betsimisaraka suture from the Madagascar cross over to the Indian sub-continent at the Karwar Kumta region (Karwar–Kumta suture zone), as well as the northernmost part of Dharwar Craton. Even though it was structurally and geochronologicaly challenged by other workers they accept the correlation between the Mercara Shear Zone and the ca. 2.4 Ga Betsimisaraka Suture Zone in east-central Madagascar.

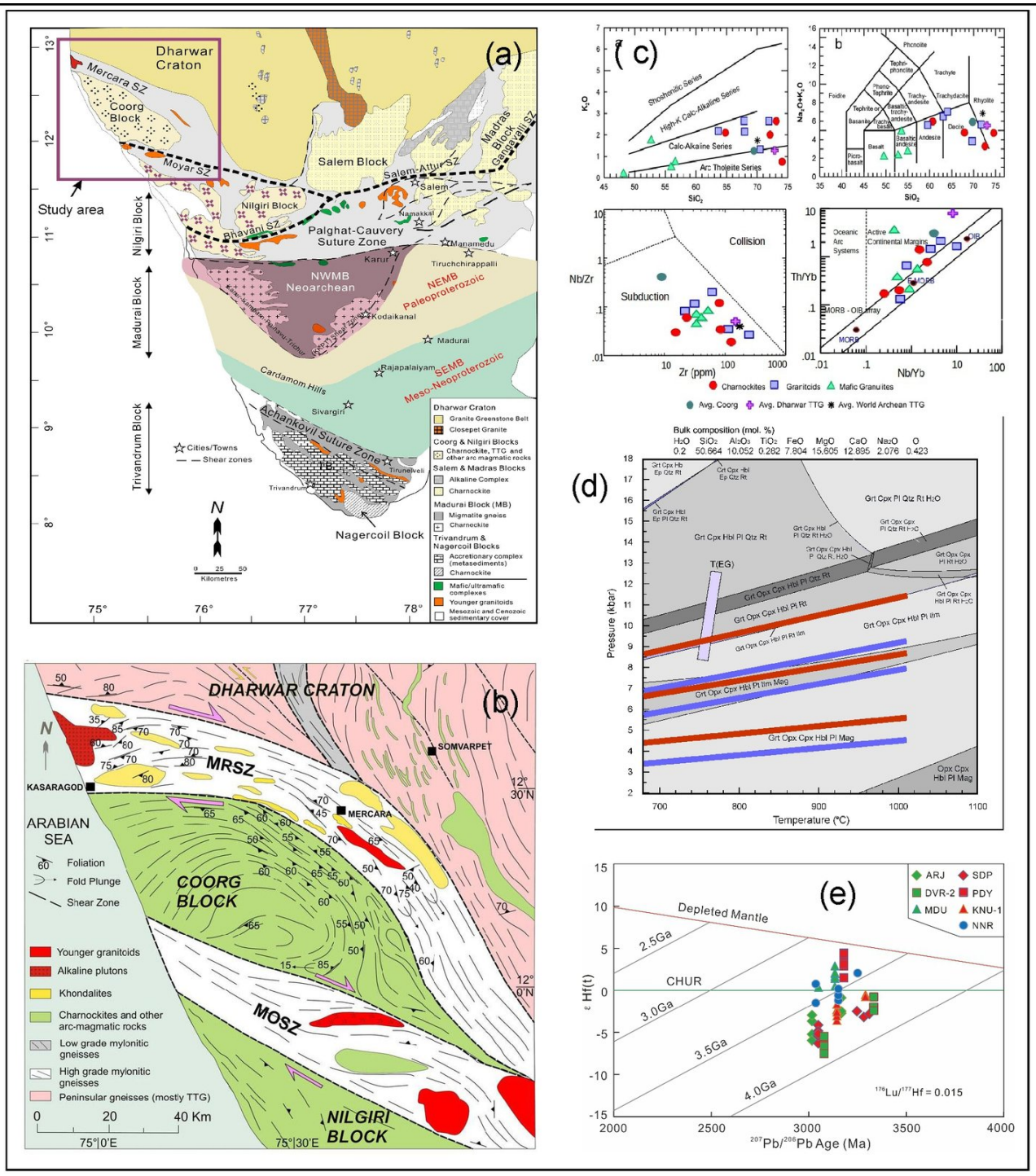
In this context our study try to elucidate the geological, petrological, geochemical, geochronological and genetical aspects from a suite of metaigneous (TTG-related gneisses, charnockite, metagabbro, mafic granulite) and metasedimentary (quartz mica schist, khondalite, garnet biotite gneiss, kyanite-sillimanite bearing metapelite) rocks from Mercara Shear Zone.

Conventional geothermobarometry and pseudosection computations indicate that the metapelites and mafic granulites from the Mercara Suture Zone have undergone high grade metamorphism at granulite facies conditions, possibly associated with a collisional event. Geochemical data on the magmatic suite suggests formation through subduction-related arc magmatism, whereas the metasediments represent volcano-sedimentary trench sequences (Fig. 1c). The fluid inclusion microthermometry of inclusions in quartz and garnet reporting high-density carbonic (1.15 g/cm^3) fluids from the charnockites and mafic granulites. The fluid inclusion data extracted from these granulites is in conjunction with the mineral thermobarometry of the terrain and suggest deep subduction and subsequent exhumation (Fig. 1d).

The zircon U-Pb age data from the magmatic rocks indicate crystallization ages between 3.1 Ga. to 3.2 Ga Ma whereas the detrital zircons from the sedimentary sequences provide an age range of 3.1 Ga to 3.5 Ga. The tightly defined ages of 3.1 to 3.2 Ga from igneous zircons in the magmatic suite suggest prominent Mesoarchean convergent margin magmatism. Hf isotope features suggest magma derivation mostly from juvenile sources and the Lu–Hf model ages indicate that the crust building might have also involved partial recycling of basement rocks as old as ca. 3.8 Ga (Fig. 1e).

The zircon data in our study clearly show metamorphic overgrowth at ca. 3.0 Ga suggesting collisional suturing in the Mesoarchean, rather than Neoarchean or Mesoproterozoic. It is possible that the younger events recorded in the other studies represent reactivation of a Mesoarchean suture. Future studies focusing on the timing of metamorphism of the rocks along this suture might provide further insights into this intriguing problem and the debate over the age and reactivation history of the Mercara Suture Zone. Our study defines the Mercara Shear Zone as a terrane boundary, and possible Mesoarchean suture along which the Coorg Block was accreted to the Western Dharwar Craton.

Keywords: Petrology and Geochemistry, Fluid Inclusion, Zircon Geochronology, Mercara Suture Zone, southern India



Figs. 1(a) Generalised tectonic framework of Southern India
(b) Detailed Geology map of Study area (c) Geochemical differentiation diagrams
(d) Combined mineral phase diagram with Co2 isochores
(e) εHf (t) versus 207Pb/206Pb age diagram of zircons

Significance of corona textures in ultrahigh temperature metamorphic assemblages: A study between southern Indian and east- Antarctican sections

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Lithological relationships between continents have been an important topic of research for geoscientists for the past decades. A number of tools are used in developing the updates regarding this topic, and petrology is the rarest among them. In this study, a significant similarity between the mineralogical and textural assemblages are reported between samples from east Antarctica and southern India using corona textures in ultrahigh-temperature metamorphic assemblages.
The region of Enderby Land in north-eastern Antarctica consists of regionally metamorphosed amphibolite to granulite facies rocks. This can be divided into several sub-regions such as- Napier complex (Archean), Rayner complex (Proterozoic), Lützow Holm complex (late Paleozoic) and Yamato-Belgica complex (early Paleozoic). Samples from Akarui point, LHC consist of porphyroblastic corundum partly or completely rimmed by spinel-sapphirine-plagioclase coronas. The matrix assemblage is mainly coarse to medium grained calcic amplibole and minor Fe-Ti phases. Similar unique textural assemblage is also observed in the UHT granulites from Palghat-Cauvery shear zone situated within the Southern Granulite Terrain, southern India. In this sample first two corona around corundum (Spl and Spr) is same as the samples from Akarui point, however the outer rim is of cordierite. The amphibole matrix in the Palghat-Cauvery shear zone sample is of gedrite composition. The reaction between the amphibole matrix and corundum core are further studied towards the formation of reaction coronas and their distribution in both the scenarios. The composition of Sapphirine from both the samples shows a significantly matching peraluminous distribution. The results enable us to undertand the role of local bulk chemical composition in the textural formation at similar metamorphic condition. The resulting observations are further studied through the aspects of correlating continents and a new implication is made considering the two regions as counterparts for the giant Gondwana jigsaw puzzle.

Keywords: UHT, Gondwana, Corona

Petrology and Geochemistry of Metamorphic rock from the Kabul Block, Afghanistan

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1. Introduction

Afghanistan is located in the tectonically active collision zone between the Eurasian and Indian Plates, which is the reason that has complex geology. Tectonically Afghanistan is composed of a series of terranes which split from the main Gondwanan supercontinent before colliding, with each other, or with the Eurasian plate (Sengor, 1984; Boulin, 1988; Treloar and Izatt, 1993). The northern part belongs to Eurasia, The Central is made up of accreted fragments of Gondwanan supercontinent, and south East belong to India Plate.

The Kabul Block is a tectonic fragment that occurs at the junction between the Indian and Eurasian plates. Along with the Farah and Helmand Blocks, it is part of a series of NE–SW aligned terranes that comprise the Central Afghanistan Blocks. (Abdullah and Chmyriov, 1977). The Basement rocks in Kabul block are metamorphic rocks covered by sedimentary rocks and intruded by granitoids. Basement rocks are exposed in the central part of the Kabul and these rocks are represented by three formation, called the Sherdarwaza, Kharog and Welayati Formations (Abdullah and Chmyriov, 1977; Karapetov et al., 1981; Bohannon, 2010). which are consist of amphibolite, biotite gneiss, mica schist, migmatites and small amounts of higher-grade granulite-facies rock.

2. Abstract

We are reporting petrology and geochemistry of metamorphic rocks from the Kabul block. The importance for this study is that there is no recent systematic and detailed petrographic and geochemical studies for metagranite and amphibolite from the Kabul block. These metagranites and amphibolites occur in northeastern and southern parts of Kabul city, respectively.

Metagranite cropped out in the northern part of the Kabul city, the boundary between metasedimentary rocks and metagranitic rocks are not clear and difficult to distinguish because of the sediments that are covered the area.

The garnet amphibolite and garnet-bearing mica schist are dominant in south part Kabul block, the amphibolite exhibits metamorphic foliation, The main mineral assemblage of the metagranites are biotite +plagioclase + K-feldspar + quartz ±kyanite ±sillimanite ±rutil ±garnet. Some metagranites contain sillimanite as inclusion in garnet and kyanite in the matrix, suggesting P-T change from sillimanite stability field to kyanite field. Corundum and spinel are rarely observed from highly aluminous domain in metagranite sample.

Aluminum saturation index ($Al_2O_3/(CaO+Na_2O+K_2O)$ in metagranite samples is higher than -1.0, In the Rb against Y + Nb diagram (Pearce et al., 1984), the metagranites show affinities to volcanic arc granites (VAG).

Main mineral assemblage of amphibolites is (hornblende + plagioclase + quartz + epidote + titanite + opaque), and that of garnet amphibolites is similar, except the presence of garnet. The TAS (Total Alkali Silica) & AFM discrimination diagram, all Amphibolite rocks plot in basalt field, with the signature of E-MORB.

The result of FE-EPMA dating of monazite from metagranite indicates ca. 800 Ma, 1400 Ma and 1900 Ma

for the timing of metamorphic event in this area metamorphism. We will add result of zircon U-Pb and discuss P-T-t history of metamorphic rocks in the Kabul block.

