Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SGL40-01 Room:201A Time:May 19 14:15-14:30

Application of laser-heating 40Ar/39Ar dating to the studies of subduction initiation process

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Submarine volcanic rocks are known to give ages different from their true eruption ages in some cases (e.g. Seidemann 1977). This is due to the existence of excess ^{40}Ar in the rapidly quenched glass or Ar loss and K remobilization caused by reaction with seawater or hydrothermal fluids. Stepwise-heating analysis in ^{40}Ar/^{39}Ar dating is particularly useful for dating submarine volcanics because:1)it can provide means of detecting contribution of non atmospheric component (isochron plot), 2)extensive pre-analysis sample treatment (i.e., acid leaching, pre-heating of samples at relatively high temperature before analysis) is possible to reduce contribution from alteration phases, 3) by combined with laser-heating procedure, it can be applied on very limited amount of suitable material for dating.

We are applying this dating technique to reveal time scale and timing of process of subduction initiation along the Philippine Sea Plate, i.e., initiation of Izu-Bonin-Mariana arc. Dating of forearc crustal section of this arc revealed that the first basaltic magmatism at subduction initiation was produced by decompression melting of the mantle and took place at 51-52 Ma. The change to flux melting and boninitic volcanism took 2-4 m.y., and the change to flux melting in counterflowing mantle and more normal arc magmatism took 7-8 m.y.

These dating results also provide implication about the location and cause of subduction nucleation. The 51-52 Ma age of subduction nucleation in the IBM system strongly implies that the IBM arc initiated before the onset of sea-floor spreading in the West Philippine Basin. The potential location of subduction nucleation could be along the Mesozoic-aged arc terrane that is now found along the margins of the West Philippine Basin. This implication could be significant when along-strike variation of crustal structure and geochemical characteristics of arc magma are considered.

The contemporaneousness of IBM forearc magmatism with the major change in plate motion in Western Pacific at ca. 50 Ma suggests that the two events are intimately linked. Published numerical models of subduction initiation require at least 100km of convergence before a subduction zone nucleates, and self-sustaining subduction occurs (Hall et al., 2003). During the earliest stage of subduction, rapid trench retreat causes extension and decompression melting to generate forearc basalts from asthenospheric mantle. If this is correct, then 51-52 Ma age for onset of the basaltic magmatism can be considered as the age of initiation of slab sinking followed by self-sustaining subduction.

This age nearly coincides with the best estimate of the change in motion of the Pacific Plate deduced from the age of the Hawaiian-Emperor bend (c. 50 Ma: Sharp and Clague, 2006). Because the volcanism appears to be nearly synchronous with the change in plate motion, it appears that it was the onset of subduction that changed the plate motion. But it is still too early to reach this conclusion since we need to understand the period of subduction nucleation along the entire length of western Pacific margin with better precision. Systematic chronological study of ophiolite sequence (corresponding to early arc crustal section) in this area as well as the submarine forearc section will provide critical constraints to this discussion, and could contribute to finalize the discussion about whether subduction initiation is spontaneous or induced (e.g., Stern, 2004).

Keywords: 40Ar/39Ar dating, subduction initiation, Izu-Bonin-Mariana arc

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SGL40-02 Room:201A Time:May 19 14:30-14:45

Argon isotope mass fractionation to light isotope enrichment in volcanic rocks

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The basalt magma generated in the upper mantle must be in excess argon environment by the radiogenic 40Ar derived from 40K decay in the upper mantle as suggested from mantle-derived materials reported by Kaneoka and Takaoka (1980). In fact, the submarine basalts from the crest of the East Pacific rise give the older K-Ar ages up to 460 Ma (Funkhouser et al., 1968). The submarine pillow basalt lavas from Kilauea volcano, Hawaii give the extremely old K-Ar ages (43 Ma) in the quickly cooled rim part in comparison with the ages (1 Ma) in the slowly cooled core part (Dalrymple and Moore, 1968). Ryu et al. (2011) reported the quarse-grained olivine phenocrysts in the basalts from the central part of Korean Penissula were extremely older (38 Ma) than the groundmass feldspar (0.5 Ma). These results suggest the source magma had the excess argon, which has remained in the quick cooled pillow lavas and the coarse-grained olivine phenocrysts.

The island arc type magma is produced through the partial melting of mantle wedge peridotite (Tatsumi, 1986). This suggests that the magma were also in excess argon environment because the magma formed in the wedge mantle. The argon diffusion process from magma during the eruption makes more excess argon environments. However, the historical lavas have experienced the argon isotope mass fractionation to light isotope enrichment (Matsumoto et al., 1989) and the late Pleistocene volcanic rocks in Japan, New Zealand, Hawaii and China have frequently the ratios of 38Ar and 36Ar lower than the atmospheric ratio (0.187). This confirms the mass fractionation to light isotope enrichment is common in volcanic rocks.

When, where and how the mass fractionation from the atmospheric argon isotopes takes place during the magma generation and eruption process? Itaya and Nagao (1988) and Itaya et al. (1989) pointed out that the most likely location for the mass fractionation from the atmospheric argon could be in the magma reservoir in the earth crust, probably in the shallow reservoir where the magma may easily interact with the atmospheric argon transported from out of the reservoir through underground water or seawater based on Ueda and Sakai (1984) who revealed that there was a significant interaction between magma and seawater in the magma reservoir of Satsuma Iwojima volcano, south of Kyushu, Japan. We have a working hypothesis that the magma just before eruption has already the mass fractionated isotopes. Itaya and Nagao (1988) and Itaya et al. (1989) reported that the post caldera stage lava of Aso volcano has significantly different 36Ar content and the same ratio of 38Ar and 36Ar in the slowly cooled part and in the quickly cooled basement part. This shows that the mass fractionation did not take place during the degassing process in the lava flowing and the isotopic ratio in the magma reservoir did not change in the process. On the basis of this hypothesis, we propose a mixing model for the mass fractionation to light isotope enrichment. We interpret that the mass fractionation to light isotope enrichment takes place during infiltration of groundwater or seawater with the atmospheric argon isotopes into the magma reservoir with the mass fractionation law analyzed numerically (Ryu et al., 2010). When the water with mass fractionated argon isotopes interact sufficiently with the magma having the excess argon isotopes in the reservoir, the magma will have the argon isotopic ratios on the fractionation line. In this case, the mass fractionation correction is valid to get reliable ages. The insufficient interaction makes the isotopic ratios above the mass fractionation line, giving unreliable ages.

Keywords: volcanic rocks, argon, mass fractionation, light isotopes, mass fractionation correction age

Japan Geoscience Union Meeting 2013
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SGL40-03 Room:201A Time:May 19 14:45-15:00

Terrestrial radiocarbon calibration dataset from Lake Suigetsu 1993 and 2006 varved sediment cores

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See Japanese abstract (the presentation will be in Japanese).

Keywords: Lake Suigetsu, SG06, Radiocarbon, IntCal, Varve

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SGL40-04 Room:201A Time:May 19 15:00-15:15

U-Th dating of sulfide minerals from a hydrothermal vent -comparisons with other dating methods-

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The time scale for hydrothermal activity is an important factor controlling the size of hydrothermal ore deposits and the evolution of chemosynthesis-based communities in a submarine hydrothermal system. Radioactive isotopes with short half lives such as ^{210}Pb have been mainly used for dating of sulfide minerals in seafloor hydrothermal systems. Lalou et al. (1985) obtained young ^{210}Pb-Pb ages (<100a) for sulfide minerals from axial ridge of East Pacific Rise (12°N 50') where the spreading rate is large. However, they could not detect ^{230}Th for the minerals with alpha spectroscopy. ^{234}U-^{230}Th ages were successfully obtained for sulfide minerals from TAG area on the slow spreading mid-Atlantic Ridge using a thermal ionization mass spectrometry (TIMS). We applied ^{234}U-^{230}Th radioactive disequilibrium dating to sulfide minerals from a sulfide crust collected in South Mariana Trough where spreading is fast with the use of MC-ICP-MS. We also compared the ^{234}U-^{230}Th ages of sulfide minerals with ESR and ^{226}Ra-^{210}Pb ages of barite from the same sulfide crust. A slice of the crust which was further cut into 13 pieces were used this study.

^{234}U-^{230}Th and ESR methods yielded age of 0.27 ~ 2.2 ka. Two ages are consistent in most of samples. The crust also showed continuous ^{234}U-^{230}Th ages which suggest continuous growth. Noguchi et al. (2011) applied ^{226}Ra-^{210}Pb dating to barite from the same crust and reported young (30-40 years) ages. The different ages of ^{226}Ra-^{210}Pb system may have been caused from continuous growth of the sulfide crust. Here we assume a volumetrically continuous growth model of a sulfide crust to examine the behaviors of ^{234}U-^{230}Th and ^{226}Ra-^{210}Pb pairs. When each part of the sulfide crust precipitates, it contains ^{234}U and ^{226}Ra but no ^{230}Th and ^{210}Pb. The precipitated part is kept as a closed system. After the continuous growth for 2,000 a, the crust with a mean age of 1,000 a is sampled for analysis. If all part of the sulfide crust mixed thoroughly, ^{234}U-^{230}Th system yields 997 a, while ^{226}Ra-^{210}Pb system yields 84.9 a. The result of the calculation demonstrates that ages based on a shorter-lived radioactive isotope are biased by younger material addition. The discordant ages found between the ^{234}U-^{230}Th and ESR ages obtained in this study and ^{226}Ra-^{210}Pb ages reported by Noguchi et al. (2011) could be caused by continuous growth of the sulfide crust. The similar disconcordant ages were reported for opals precipitated from ground water (Neymark et al., 2000).

Our results demonstrated that sulfide deposits of a $>$ 10 cm thickness can record the evolutional history of hydrothermal activity of $>$ 1 ka. The application of MC-ICP-MS allowed improved geochronological resolution of U-Th disequilibrium ages and has lowered the required sample amount to less than 2 g.

Keywords: hydrothermal vent, U-Th radioactive disequilibrium dating, ESR dating, inconsistent age

Japan Geoscience Union Meeting 2013
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SGL40-05 Room:201A Time:May 19 15:15-15:30

History of Hakusan volcano studied by multi-chronology

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The Hakusan volcano locates at the border between Ishikawa, Fukui and Gifu Prefectures. Existence of a magma reservoir is recognized by the seismicity (Takahashi et al., 2004), so that possibility of future eruption has been worried in recent years. Therefore, detailed analysis on the magmatic and volcanic history of the Hakusan volcano is necessary. The Hakusan volcano consists of Kagamuro (300˜400ka), Ko-hakusan (100˜140ka), Shin-hakusan (volcanic activity is further divided into two stages: the first (30˜40ka) and the second (˜10ka) activities), and Uguisudaira (˜20ka) volcanoes. The eruption age of each volcano has been estimated mainly by the K-Ar method (Higashino et al., 1984, Sakayori et al.,1999, etc.). However, except for Kagamuro volcano, their ages are relatively young for the age range applicable by the K-Ar method. Therefore, cross-check by other dating methods is important to confirm their eruption ages.

The purpose of this research is to date Hakusan volcano by the thermoluminescence (TL), fission track (FT), U-Th, and U-Pb methods to argue the volcanic activity. Obtained ages for the time of eruption are concordant with reported K-Ar ages.

It seems that eruption activities had occurred over a period of 60˜100 ka in the Ko-hakusan volcano, ˜50 ka in Shin-hakusan I volcano, and younger than ˜10 ka in Shin-hakusan II volcano. Crystallization ages within magma chamber is 50˜100 kyrs younger than the eruption ages.

Keywords: Luminescence dating, U-Th dating, Fission track dating, U-Pb dating

Japan Geoscience Union Meeting 2013
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SGL40-06 Room:201A Time:May 19 15:30-15:45

Development of submicron CHIME dating

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CHIME (U-Th-total Pb Chemical Isochron Method) dating[1][2][3] provides an U-Th-Pb age in microvolume using electron probe microanalyzer (EPMA). It is impossible to analyze submicron grain or domain because of X-ray generation volume at the normal analytical conditions (E0 = 15 - 25 keV). Submicron CHIME dating has been developed to perform dating of submicron size grain or domain using smaller energy of incident electron.

[1] Suzuki, K. & Adachi, M. (1991) J. Earth Planet. Sci. Nagoya Univ., 38, 11 - 37.
[2] Suzuki, K. & Adachi, M. (1991) Geochem. J., 25, 357 - 376.
[3] Suzuki, K. & Kato, T. (2008) Gondwana Res., 14, 569 - 586.

Keywords: CHIME dating, U-Th-Pb dating, submicron dating, quantitative electron probe microanalysis, matrix correction

Japan Geoscience Union Meeting 2013
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SGL40-07 Room:201A Time:May 19 15:45-16:00

Incremental granitic magma emplacements in the Hida Mountain Range as revealed by comprehensive zircon U-Pb data

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The Hida Mountain Range (HMR) is the largest and highest mountain system in Japan. The HMR is known to have the highest uplift and denudation rates during the Quaternary in Japan. Granite is the dominant lithology in the HMR and many stages of granitic magma intrusion from Mesozoic to Quaternary have been recognized, while exact timing of magmatic intrusion has been unclear because ages were mostly determined by K-Ar and fission-track dating methods with relatively low closure temperatures.

In this study, a total of 34 granitic rocks were dated by the U-Pb method on zircons using LA-ICP-MS. All of the samples were collected in and around the Kurobegawa Granite. Some zircons were dated both at the center and rim of a grain by LA-ICP-MS and SHRIMP U-Pb dating was also performed. These experiments corroborated the reliability of the dating results.

It was found that in the HMR 65 Ma granite is widespread and several discrete magmatic activities occurred since 10 Ma. The latest activity was ˜0.8 Ma, which indicates the Kurobegawa Granite is the youngest exposed pluton on Earth.

Keywords: U-Pb dating, zircon, granitic magma, Hida Mountain Range

Japan Geoscience Union Meeting 2013
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SGL40-08 Room:201A Time:May 19 16:15-16:30

Mechanism of eruption of Kumano mud volcano, Nankai accretionary prism

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Deep-rooted fluids in the accretionary prism play an important role in the occurrence of earthquakes near trench. The fluid samples from forearc mud diapirs help us to delineate possible fluid origins and/or sediment?water interactions at depth within the accretionary prisms. It is, however, difficult to research deep-seated fluids from pore water samples using traditional hydrogen and oxygen isotopic compositions owing to contamination from seawater. Lithium (Li) is relatively unsusceptible to contamination from seawater because the Li content of deep-rooted fluid is significantly higher than that of seawater. In addition, Li has two stable isotopes, 7Li and 6Li, with respective relative abundances of 92.5% and 7.5%, and 7Li/6Li ratios may provide further insight into the origin of deep-rooted fluids. We therefore analyzed 7Li/6Li ratios of pore fluids in mud volcano in the Kumano forearc basin to investigate the fluid regime in Nankai accretionary prism. In this study, we analyzed two different drilled mud cores at site C0004 and site C0005 that were recovered from center and margin of the Kumano #5 mud volcano, respectively. These samples were recovered using D/V CHIKYU that was equipped with a riser drilling system. The results show that delta 7Li values of analyzed Kumano mud volcano fluid vary from +5.5 to +10.6 per-mil (delta 7Li = [[7Li/6Li]sample/[7Li/6Li]L-SVEC standard - 1] x 1000). Judging from the delta 7Li values were correlated with the Rb/Li ratios, we argued that the lowest delta 7Li value, +5.5 per-mil, as that of a deep-derived end-member fluid. It has already reported that the delta 7Li value of decollement fluid in Nankai subduction zone is +10 per-mil (You et al., 1995. Geology 23, 37-40). Because the Cl/Li ratios are significantly lower than seawater value, the Li isotopic difference between Kumano mud volcano fluids and Nankai decollement fluids are not due to seawater contamination. Thus, our Li isotopic data revealed that the Li in Kumano mud volcano fluids are originated from deeper (higher temperature) than those in the Nankai decollement fluids. Based on the Li isotopic data, we further estimated the fluid-sediment reaction temperature is 300 degree C. Based on the results, we discuss the mechanism of eruption of the Kumano #5 mud volcano.

Keywords: lithium isotope, mud volcano, Nankai, earthquake, accretionary prism, deep-rooted fluid

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SGL40-09 Room:201A Time:May 19 16:30-16:45

Restoration of the 3.2-3.1 Ga sea floor: Local analysis of S isotope of micro-scale spherical shell pyrite in DXCL core.

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In the Western Australia Pilbara coast green stone belt, low-grade metamorphic Dixon Island Formation and Cleaverville Formation of 3.2-3.0 Ga is exposed. In these sedimentary rocks, information of the earth's surface environment of Archean and a trace of the initial life which are very important to solve geological and bilological evolution of the initial earth are left.

DXCL land drilling (Kiyokawa et al., 2012) was performed in 2007 and 2011 for the purpose of the high-resolution reconstruction of the change of past sedimentation environment in this area, and four rock core samples (DX, CL1, CL2, and CL3) were acquired.

S isotopic measurement is performed for DX, CL1, and CL2. Delta 34S value was very heavy (-1.9 - +26.8 permille: Sakamoto, MS2010), and this is different from the negative isotope fractionation of the creature source usually seen. Change of the value was in particular big in the DX core. As a result of microscopic observation of DX, we found the layer of tens-hundreds micrometer euhedral pyrites and the layer of the micro-scale spherical shell pyrites(=MSSPs; about 10 micrometer in diameter) which are fulfilled with silica.

In this study, we measured S isotope of these MSSPs planarly and observed micro-scale distribution of isotopic ratio for the purpose of revealing to what extent minutely the fractionation occurred and how these pyrites grew.

(Classification of the MSSPs) We measured 11 samples and classified them under 3 types: A type(1 sample) is pyrite shell whose inner side is filled with silica, B type(7 samples) is pyrite shell which has a pyrite grain in its center, and C type(3 samples) is spherical pyrite which is fulfilled with pyrite. We suppose that these pyrites grew from A type to C type, via B type, based on this morphological classification.

(Method) We buried a thin section of DX124.34 which includes MSSPs and a working standard in resin, and performed imaging analysis to this sample using NanoSIMS. A type was measured an enlarged part of the spherical shell in the area of 3x3 square micrometer. B type and C type were measured a whole particle in the area of 10x10 square micrometer. Measuring time varied according to a measuring domain, but we can compare the results with the same precision by regulating the number of pixels to show in either 4x4, 8x8, or 16x16.

(Result of a measurement) 1. Standard: in the measurement of the standard with isotopic homogeneous composition, measured value was not stable. However, dispersion of the value in one analysis domain was small; we reproduced the homogeneity. Therefore, not the absolute value but the relative value, or difference of the isotopic ratio in one analysis domain is important in our mapping data.

2. MSSPs: in A type, isotopic ratio showed patch-like distribution. In B type, the inner edge was higher than the outer edge, and concentric structure was seen. However, patch-like distribution like A type was also seen. In addition, pyrite grain in the center was heavier than spherical shell. In C type, a heavy domain was seen in the shape of a ring.

(Summary) 1. In A type, isotopic ratio showed patch-like distribution. However, this is only a result of 1 sample.

2. In B type, an inner edge was higher than outer edge. We suppose that spherical shell grew toward inner side and got heavy isotopic ratio because of further fractionation in closed environment. Moreover, heavy pyrite grain in the center can be thought to have been formed for the same reason. Because some B type pyrite had patch-like distribution, we suppose that MSSPs grew from A type to B type in generally.

3. In C type, the center and the outer edge was light and a heavy domain was seen in the shape of a ring. This is because heavy pyrite grew from both the inner edge and the center, and the heaviest pyrite filled the inner space at last. Therefore, we suppose that B type pyrites grew into C type.

From Summary1 to Sumaary3, we claim that MSSPs grew from A type to C type, via B type.

Keywords: micro-scale spherical shell pyrite(=MSSP), sulfur isotope, local analysis, sulfate reduction bacteria, Archean, Pilbara

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SGL40-10 Room:201A Time:May 19 16:45-17:00

Sr and Nd isotope systematics of metacarbonate rocks as proxies for extinct oceans in continental collision zones

Naho Otsuji[1*], Satish-Kumar Madhusoodhan[1], Atsushi Kamei[2]

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Geochemistry of chemically deposited sedimentary rocks, especially neodymium isotopes, is often used as an indicator to understand paleo-oceans, its relationship with continents and so on. Because of the infinitely low concentration of neodymium in sea water than that of continental material and a very short residence time in the seawater, the Nd budget of the ocean is dominated by continental source and sedimentary rocks record its local differences. In particular carbonate rocks are good indicator for understanding the relationship between continents and surrounding oceans, because it is commonly deposited in a platform environment surrounding a continent.

The Sor Rondane Mountains, located in the Neoproterozoic to Early Cambrian East African-Antarctic collisional orogen, are the best location for understanding the Gondwana amalgamation, and recently lots of new information on these mountains have been generated in terms of its geology, lithological variations, tectonic evolution, geophysics and so on. These mountains are composed of medium- to high-grade metasedimentary, metaigneous and intrusive rocks of diverse composition (Osanai et al., 2013 and references therein). Within the metasedimentary rocks, the metacarbonate rocks are considered to have deposited chemically in the so-called the ”Mozambique Ocean” that separated the continental blocks East Antarctica and southern Africa that amalgamated to form Gondwana. It is possible that the metacarbonate rocks record geochemical signatures of contemporaneous seawater. Metasedimentary rocks distribute in Northeastern area of the Sor Rondane Mountains, and the southwestern area is dominated by metaigneous rocks that were derived from the subduction of young hot oceanic crust. Recently, Otsuji et al. (2013) reported 880-850 Ma and 820-790 Ma (late-Tonian and early-Cryogenian age) depositional ages of the metacarbonate rocks by using strontium and carbon isotopic stratigraphy. However, there exist regional variations in the Sr isotopic composition and it is necessary to understand the relation with surrounding continental blocks. To achieve this, we analyzed Nd isotopic composition in pure and impure metacarbonate rocks from the Sor Rondane Mountains, East Antarctica and discuss about the relationship with continent and depositional basin of carbonate sediments before the Gondwana amalgamation. Combining the reported Nd isotopic ratio from various rock units from the Sor Rondane Mountains (e.g. Kamei et al., 2013; Nakano et al., 2013; Shiraishi et al., 2008 and reference therein), we evaluate the possible source characteristics of Nd in the platforms that potentially surrounded the Sor Rondane Basin of the Mozambique ocean.

The epsilon values of Sr and Nd from pure carbonate rocks are lower than metaigneous rocks from the southeastern area in the Sor Rondane Mountains. A clear trend is also visible in the order from metaigneous rocks (rocks in the southeastern area), through impure carbonate to pure carbonate rocks in the Sor Rondane Mountains, suggesting a potential mixing of continental and oceanic source. Additionally, impure carbonate rocks show a narrow range, while pure ones have wide and various distributions in each region. There is also a marked variation in Nd model ages (T_{2DM}) for pure carbonate rocks in the Sor Rondane Mountains. These imply that the age of continents that acted as sources to the surrounding sea water during timing of carbonate deposition, were possibly different. In our presentation we attempt to discuss the pros and cons of using metacarbonate rocks which can lead to review the process during continental collision, and before and after that.

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Keywords: Sm-Nd isotopic composition, metacarbonate rocks, chemostratigraphy

Japan Geoscience Union Meeting 2013
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SGL40-11 Room:201A Time:May 19 17:00-17:15

Timing of regional metamorphism in the Hida Belt and Unazuki area

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The Hida Belt is one of crucial sites for deciphering the Permo-Triassic orogeny in East Asia and is important for discussing the eastern extension of the Triassic continental collision between North and South China Cratons in the Japanese Islands. The Hida Belt consists of granitoids and metamorphic complex which consists mainly of paragneisses, orthogneisses, amphibolite and marble with multiple episodes of metamorphism evident, as based on petrography. However, the timing and duration of the regional metamorphism is still controversial, because radiometric ages mainly determined by Rb-Sr and K-Ar methods are scattered from 240 Ma to 220 Ma. The Unazuki area, situated at the northeastern part of the Hida Belt, has experienced the kyanite-sillimanite type metamorphism characterized by a clockwise P-T path. Radiometric ages of the Unazuki schists, previously determined by Rb-Sr and K-Ar methods, are scattered from 248 Ma to 175 Ma primarily because of multi-phase metamorphism and deformation. In this study, U-Pb zircon geochronology was applied to Hida gneiss in the Kagasawa area and the Unazuki schists to discuss about timing of the regional metamorphism in the Hida Belt and the Unazuki area.

Zircon grains of the Hida gneiss sample are rounded to well-rounded in habit. Cathodoluminescence images of zircon revealed that overgrowth rim surrounds oscillatory zoning core. The oscillatory zoning core yieled ca. 251 +/- 2 Ma. U-Pb age of the overgrowth rim with low Th/U ratio is ca. 247 +/- 1 Ma, which suggests that the regional metamorphism started between 251 and 247 Ma in the Kagasawa area.

On the other hand, in the Unazuki area, U-Pb data of quartzo-feldspathic schist derived from felsic volcanics yield an eruption age of 258 +/- 2 Ma, indicating that regional metamorphism occurred after 258 Ma. U-Pb age of a granite in north part of the Unazuki area is 253 +/- 1 Ma. The granite contains some xenoliths of the Unazuki schist, in which staurolite is replaced by andalusite and cordierite due to thermal flux from granitic magma. Therefore, regional metamorphism occurred between 258 and 253 Ma, suggesting a rapid metamorphic progression. 251 +/- 1 Ma of gneissose quartz diorite containing the Unazuki schists supports the timing of the regional metamorphism.

Keywords: zircon, U-Pb, Hida Belt, Unazuki, SHRIMP

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SGL40-12 Room:201A Time:May 19 17:15-17:30

U-Pb ages of Cretaceous granitic and mafic rocks of SW Japan and their geological implication

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The Cretaceous granitic province in Southwest Japan has been subdivided into San-yo zone in back-arc side and Ryoke zone in fore-arc side. The granitoids in the Ryoke zone are classified into Younger Ryoke granitoids and Older Ryoke granitoids.

It has been noticed since old days that the granitoids from the eastern part of SW Japan (Chubu district) give relatively young ages compared to those from the western part (Yanai district). Since 1990s, eastward younging along-arc age variation of these granitoids and a ridge subduction model has provoked hot discussion. But they are based on classical K-Ar and Rb-Sr ages because U-Pb dating had not been done in Japan, then.
After middle 1990s, U-Pb ages of the granitoids and accompanied mafic rocks using ion microprobe and ICP-MS have been documented. They gave the following results.

1) The U-Pb ages of the San-yo zone granitoids and Younger Ryoke granitoids show the polarity of eastward younging from cc.95Ma to 70Ma.
2) The ages of the Older Ryoke granitoids are nearly constant with rather broad range of 98-85Ma all the way from west to east of SW Japan.
3) The ages of mafic rocks including MMEs, synplutonic dikes and layered gabbros in the Chubu and Kinki districts are distinctly younger than the associated Ryoke granitoids. The ages of mafic rocks are similar to those of the San-yo zone granitoids of similar along-arc positions, seemingly following their along-arc polarity.

Along-arc age variation of the San-yo granitoids is clearly shown by also CHIME ages on the Chubu and Yanai districts (Suzuki and Adachi, 1998).
The results 1) to 3) above lead us to another view that we have not seen.

1. The San-yo and Ryoke granitoids should be re-categorized. The Younger Ryoke granitoids have to be re-defined or re-named in another grouping. Or it may be better to quit the name of San-yo and Ryoke granitoids at least in the meaning so far used.
2. Two types of magmatism took place at the site of the Cretaceous Japanese Islands. One is 95-85Ma plutono-metamorphism which prevailed whole SW Japan. Another one is along-arc traveling magmatism which is now exposed in the erosion level of volacano-plutonic complexes.
3. The mafic rocks now exposed in the Ryoke belt were product of the along-arc traveling magmatism.

Mafic rocks are exposed much less in the San-yo zone compared to those in the Ryoke zone. Mafic magma that intruded in the present San-yo zone may have contributed as a source material of the granitoids of the San-yo zone. Next, we need a tectonic model that allows the apparently crossing two age trends of magmatism in a single geologic site in the tectonic setting of a continental margin.

Keywords: granitic rocks, U-Pb age, SW Japan, Cretaceous, Ryoke/San-yo, gabbro