Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SVC052-01 Room:302 Time:May 26 14:15-14:30

Scope of the session

Toshitsugu Fujii[1*]

[1]NPO CeMI

Prof. Kuno made enduring contributions to the volcanology through the study of Hakone volcano, and to the development of mantle petrology through the study of ultramafic nodule. He proposed an excellent model on the magma genesis in the subduction zone before the establishment of the plate tectonics, and his model stimulated the development of the high pressure experimental petrology. He was anxious to analyze the lunar rocks recovered through Apollo 11 project, but could not make it by his demise on August 6, 1969. On the occasion of the 100th anniversary of his birth, recent development in the above broad fields will be discussed.

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SVC052-02 Room:302 Time:May 26 14:30-14:45

Professor Kuno in the age of paleomagnetism, university unrest,and Apollo project

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Beside his epoch-making work in volcanology, Professor Kuno was known as a dedicated teacher and was respected for his unselfish service to the scientific community. I was very fortunate to have had a close interaction with this great scientist in my younger days not only in science, but also in non-scientific matters. The former includes our joint work on a paleomagnetic study of the Izu-Hakone volcanoes and his zealous participation in the Apollo project, and the latter includes his efforts to calm radical students during the period of Todai student unrest. I would like to introduce those moving aspects of the late Professor Kuno, who deserves to be remembered by the scientific community, especially by younger students.

Keywords: paleomagnetism, university unrest, Apollo project

Japan Geoscience Union Meeting 2011
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SVC052-03 Room:302 Time:May 26 14:45-15:00

Hisashi Kuno - Triumph of the Spirit

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As a young American boy living in Japan from 1955-1960, I was well aware of Japans path toward recovery from the devastation of the Pacific War. Whole sections of Yokohama, where I lived, remained in impoverished condition, and many parts of the city were still being rebuilt. In the late 1960s, while first studying petrology, I became aware of the work of Hisashi Kuno, and of his role in the United States as an ambassador for Japanese science and especially petrology. Following the war, Kuno was one of the first Japanese scientists to travel to the United States, where he worked on pyroxenes with Harry Hess at Princeton University. His paper about Hakone volcano, and later papers about pyroxenes, rock series, magmatic differentiation and parental magmas in Japan and elsewhere became standard fare for American petrologists wishing to understand island arcs and igneous petrogenesis. Reading about his life, I discovered how seriously the war years delayed his scientific work, and came to appreciate the obstacles he overcame in order, finally, to finish his dissertation in 1948, 17 years after he began, and while Japan itself was still in very dire straits. Then he went on to an exemplary career - helping to carry Japanese science to a level of international awareness and acceptance it had never had before. His secrets seemed to be great perseverance, assiduous attention both to detail and to all aspects of a particular problem ? especially pyroxenes, diligence and great skill with the microscope, publication in English and a level of serene authority that worked well with students and colleagues. He obtained mastery in his craft during a period of great adversity, in a way that is to me particularly Japanese in mind and spirit.

Keywords: history of geology, igneous petrology, island arcs, pyroxenes, differentiation

Japan Geoscience Union Meeting 2011
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SVC052-04 Room:302 Time:May 26 15:00-15:15

The nature of basement rocks in the Izu Peninsula and Izu-Bonin arc: constraint from zircon geochronology

Kenichiro Tani[1*], Richard S. Fiske[2], Daniel Joseph Dunkley[3], Osamu Ishizuka[4], Teruki Oikawa[4], Ichiyo Isobe[5], Yoshiyuki Tatsumi[1]

[1]IFREE, JAMSTEC, [2]Smithsonian Institution, [3]NIPR, [4]GSJ, AIST, [5]Niijimamura Museum

The Izu Peninsula, central Japan, is situated in a zone where the active intra-oceanic Izu-Bonin arc has been colliding with the Honshu arc for the past 15 million years. As a result of this arc-arc collision, parts of the Izu-Bonin upper crustal sequences have been accreted and uplifted to form the Izu Peninsula, exposing seafloor volcaniclastic deposits, associated lava flows, and coeval intrusive bodies. Parts of this sequence, the Yugashima Group, have been subjected to extensive hydrothermal alteration, and these altered rocks have previously been interpreted as representative of hypothetical widespread Middle Miocene basement that presumably underlay northern Izu-Bonin arc volcanoes. New zircon U-Pb ages presented here, however, show that both fresh and altered volcanic sequences exposed in Izu Peninsula are broadly contemporaneous and were products of the same Late Miocene to Pleistocene magmatism. Geochemical characteristics of these sequences show them to have formed in the Izu-Bonin rear-arc environment, providing an unusual opportunity to investigate in detail the growth and architecture of a rear-arc region in an active intra-oceanic arc. Moreover, zircon ages from altered basal units of Kozushima and Niijima, Quaternary volcanic islands in the northern Izu-Bonin rear-arc, show that these islands rest on units only slightly older ($<$1 Ma) than the main body of these subaerial edifices, not, as previously believed, part of a regional older Miocene basement, suggesting the near-continuum growth of these arc volcanoes and their underlying successions. The newly obtained ages and reinterpretation of the geochemical characteristic of the volcanic rocks revealed the nature of the upper crustal sequences that underlie the Izu-Bonin arc volcanoes, as well as providing key insights on the tectonic interpretation of the Quaternary volcanism in the Izu collision zone.

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SVC052-05 Room:302 Time:May 26 15:15-15:30

Geological meaning of the swarm earthquake occurrence in Hakone Volcano -Relation for Tanna and Hirayama Faults-

Yohei Yukutake[1*], Ito Hiroshi[1], Ryou Honda[1], Masatake Harada[1], Toshikazu Tanada[2], Akio Yoshida[1]

[1]Hot Springs Research Institute of Kanaga, [2]NIED

1. Introduction

Tanna Fault is the active fault of N-S strike, that is located in the central part of the Izu peninsula. Kuno (1930) found that Tanna Fault was the strike-slip type having horizontal displacement of approximately 1km. This observation was innovative knowledge at that time.

On the other hand, Hakone volcano is located at the northern extension of the surface traces of the Tanna Fault. Within the caldera of Hakone volcano, there has been fumarolic activity around the Owakidani area. Takahashi et al. (1999) suggested that a pull-apart tectonic region is produced around Hakone volcano by the activity of two faults: Tanna and Hirayama Faults, and strongly related to the formation for the structure of Hakone caldera.

In this presentation, we will review previous studies about the relation between Hakone volcano and Tanna Fault, and show our recent results that suggest the relation between the occurrence of swarm earthquakes in Hakone volcano and the activities of Tanna Fault.

2. Swarm earthquake activities in Hakone volcano

Many intense periods of swarm activity have occurred in the caldera and have been reported since 1786 (Hiraga, 1987; Mannen, 2003). Strong ground motion and fumarolic activities have occasionally been accompanied by intense swarm activities (Mannen, 2003). Mannen (2003) reported that the swarm earthquakes and geothermal activities were prevalent after the occurrence of the 1930 Kita-Izu Earthquake. In recent years, the earthquake swarms were remarkably prevalent in 2001, 2006 and 2008-2009, accompanied with crustal deformation in and around Hakone volcano.

Several studies proposed that the structures developed by strike-slip fault system contributed to the formation of high permeable channel for hydrothermal water from deep-seated magma source. Sibson (1987) indicated that fracture systems develop within a pull-apart region (dilational fault jog), due to local extensional stress resulting from the interaction of the fault system. Sibson (1996) proposed a model to explain swarm activity in which earthquakes are triggered by fluid migration through the highly permeable fracture systems. Curewitz and Karson (1997) pointed out that many hot springs and geothermal activities are found in an area such as a pull-apart region where two faults meet. They also suggested that the fracture systems developing in these areas are likely to become pathways for magmatic fluid from deep regions, playing an important role for the production of hot springs.

3. Swarm earthquake occurrence based on the hypocenter distribution

To discuss the relation between the swarm activities and tectonic setting in and around Hakone volcano, we precisely determined hypocentral distribution in Hakone volcano. Yukutake et al. (2010) found that most swarm earthquakes are distributed on vertical thin plane-like zones with width/length of 100 m to 1 km, and these plane-like hypocentral distributions range from the E-W to N-S strikes. Since Hakone volcano is located in the interaction area of the active Tanna and Hirayama faults, Yukutake et al. (2010) suggested that the fracture planes revealed by the relocated hypocenter distribution have been developed by the activity of the two active faults. Moreover, Yukutake et al. (2011) determined the hypocenter and focal mechanism distribution of the swarm activity in 2009, by using the dense seismic station network data operated in and around Hakone volcano. We found that the swarm earthquakes exhibited a migration of hypocenters that appears to be represented by the diffusion equation, and concluded that the swarm earthquakes were triggered by the diffusion of highly pressured fluid within the fault damage zone.

We think that the occurrence of swarm earthquakes in Hakone volcano is strongly related to the high permeable fault network that was formed by the interaction of two active faults: Tanna and Hirayama Faults.

Keywords: Tanna Fault, Hakone volcano, Swarm earthquake, Hypocenter distribution

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SVC052-06 Room:302 Time:May 26 15:30-15:45

Geological evolution of the Hakone volcano: Kuno's classical model vs. recent model

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The Kuno's classical model of the geological evolution of the Hakone volcano is famous for Japanese volcanologists and contributed so much to the development of volcanic geology in Japan, but Kuno's model was proposed before the appearance of plate tectonics. The theory of plate tectonics yielded the view that the Izu-Ogasawara arc is colliding with Honshu arc just around the Hakone volcano, which has greatly influenced the geological evolution of the Hakone volcano. The recent model based on the active tectonics around the Hakone volcano is different from Kuno's classical model. The Kuno's classical model is as follows; (1) the construction of a basaltic to andesitic large conical stratovolcano just like the Fuji volcano, associated with parasitic volcanoes such as the Kintoki andesitic polygenetic volcano and Makuyama dacitic monogenetic lava dome, (2) the collapse of a large stratovolcano without volcanic activity gave rise to the Glencoe-type older caldera, (3) the effusion of thick andesitic to dacitic lavas filled the older caldera to construct a shield volcano, (4) the explosive large-scale eruption of dacitic magma resulted in the collapse of shield volcano to form the Krakatau-type younger caldera, (5) the central cone has been built in the younger caldera.

Contrarily, the recent model based on the active tectonics related to the arc-arc collision is as follows; (1) from 0.65 to 0.23Ma, a lot of basaltic to andesitic intermediate to small scale polygenetic volcanoes were constructed, associated with some andesitic monogenetic volcanoes, (2) from 0.23 to 0.13Ma, the NW-SE trending graben with monogenetic volcano group cut across the volcanic edifice under the extensional tectonic regime, in the central portion of which several small scale Nigorikawa-type older calderas were constructed by large scale explosive eruptions of felsic magma, (3) from 0.13 to 0.08Ma, the eruption of dacitic to andesitic magmas in the central portion of caldera gave rise to many thick monogenetic lava flows, accompanying explosive eruptions of felsic magma, (4) from 0.08 to 0.04Ma, felsic large scale explosive eruptions occurred, the largest one of which was the eruption of Tokyo pumice resulted in the formation of Nigorikawa-type younger caldera, (5) from 0.04Ma to recent, the andesitic central cones have been constructed; the volcanic activities since 0.13Ma were restricted to the central part of the Hakone volcano, because the pull-apart structure related to the Tanna-Hirayama left lateral strike-slip fault system, cutting the central portion of the Hakone volcano, has been formed.

Keywords: Hakone volcano, volcanic history, caldera, stratovolcano, monogenetic volcano, tectonics

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SVC052-07 Room:302 Time:May 26 15:45-16:00

A new model of the Hakone Caldera

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[1]Hot Springs Research Institute

In examining 24 boreholes drilled into the morphological caldera floor of Hakone volcano, Japan, which has been considered a typical Krakatau-type caldera, we found that newly recognised, relatively fresh lapilli tuff (Facies V) and overlying sand and siltstone (Facies S) form packages that we interpret as caldera-fill deposits. Based on the extent of the packages, we propose the existence of the Gora Buried Caldera Structure (GBCS) and the Kojiri Buried Caldera Structure (KBCS); we also infer the existence of two additional buried caldera structures. Based on the fossil pollen flora within Facies S and the age of a subsided lava block (Sub-facies XY), the subsidence ages of the GBCS and KBCS are determined to be younger than the caldera-forming stage (MIS 4). It is also inferred that the GBCS subsided during an older stage of caldera formation (MIS 7). The buried caldera structures are likely to be funnel or Nigorikawa-type calderas, a caldera type proposed by several studies that examined small calderas. Previous studies have interpreted the lapilli tuff that fills funnel calderas to be a fall-back deposit, representing blown-off material consisting of disintegrated vent rocks and essential ejecta; however, we interpret such caldera fill to be collapsed material rather than fall-back material, and, based on subsurface geology, we see no grounds for distinguishing funnel calderas from maar?diatreme systems. Some of the buried caldera structures at Hakone clearly formed within a pull-apart system associated with an offshoot of the Hirayama and Hakonemachi?Miyagino faults, which traverse the volcano. The buried caldera structures appear to only slightly modify the morphological caldera wall to create embayment structures; however, the fundamental caldera morphology seems to be controlled by tectonic structures rather than the newly found buried caldera structures.

Keywords: Hakone Volcano, caldera, Nigorigawa type caldera

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SVC052-08 Room:302 Time:May 26 16:00-16:15

Petrology of the Hakone volcano ; on the bases of rock forming minerals

Teruaki Ishii[1]*

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My petrological studies of the Hakone volcano were initiated by the late Professor Hisashi KUNO.

The Hakone volcano is composed of island-arc type tholeiite magma, which is not dry but moderately hydrous. The following subjects were recognized. The hydrous tholeiite magma can produce arc-tholeiite series and calc-alkali series through fractional crystallization in the magma reservoir under open-system condition and closed-system hydrous condition for water, respectively.

Crystallization trends of rock forming minerals (pyroxene, feldspar etc.) in the individual lava flow of the hydrous tholeiitic magma are represented by chemical zoning from phenocryst through microphenocryst to the groundmass in each lava. Those trends indicate degassing (or dehydrating) trends of erupted lava.

Crystallization trend of minerals of hydrous magma in the subvolcanic magma reservoir is represented by core of phenocrysts throughout lava-flow strata in each volcano. Those trends indicate water-enrichment (or hydrating) trend in the magma reservoir.

Keywords: Hisashi KUNO, Hakone volcano, pyroxene, fractional crystallization, tholeiite, calc-alkali

Japan Geoscience Union Meeting 2011
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SVC052-09 Room:302 Time:May 26 16:30-16:45

Pigeonitic rock series vs. hypersthenic rock series

Yoshiyuki Tatsumi[1]*

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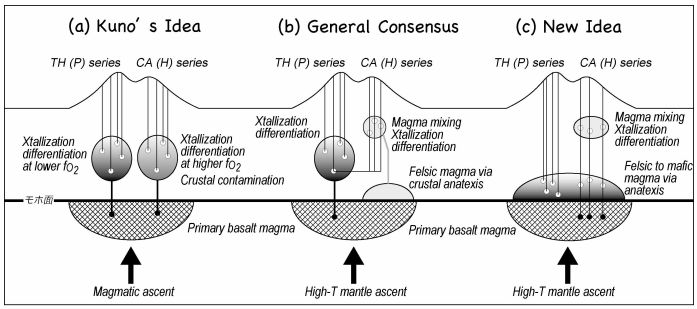
Two distinctive differentiation trends, pigeonitic and hypesthenic (P and H, hereafter), are recognized in the sub-alkalic volcanic rocks, denoting the absence or presence of orthopyroxene in a groundmass (Kuno, 1950) and correspond broadly to tholeiitic and calc-alkalic rock series (Kuno, 1960), respectively. Kuno (1959) favored a model in which P- and H-series magmas are produced from a single basaltic primary magma via crystallization differentiation under lower and higher fO2 conditions. Disequilibrium petrographic features observed characteristically in H-series rocks (e.g., Sakuyama, 1981) have led to a general consensus that these magmas form via maxing between basaltic and felsic magmas. It is generally accepted that H-series magmas may contain more crustal flavors than P-series magmas as suggested by the following observations: (1) P-series rocks are dominant in juvenile oceanic arcs, whereas H-series rocks are the major magmatic products in mature continental arcs with thicker crust and (2) H-series rocks are more enriched in 'incompatible' elements than P-series rocks. Detailed petrographic and geochemical re-examination of Quaternary volcanoes of NE Japan arc, including micro-analyses of isotopic ratios of phenocrysts, on the other hand, provides a new insight into genesis of these two magma series; the P-series magmas are produced via anatexis of lower crust caused by underplating and/or intrusion of mantle-derived basalt magmas into the sub-arc crust. The mantle-derived basalt magma mixes with crust-derived P-series melts to form H-series magmas. If this is the case, then analysis and examination of the compositions of minerals that crystallize from the primitive H-series basalt magma could provide the only chance to fully understand the geochemical characteristics of a mantle-derived magma, and hence the source mantle and slab-derived components.



Keywords: pigeonitic rock series, hypersthenisc rock series, tholeiitic rock series, calc-alkalic rock series, primary magma, magmatic diferentiation

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SVC052-10 Room:302 Time:May 26 16:45-17:00

Two magmatic series through separation of slab-derived supercritical fluid into aqueous fluid and melt

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We will review two magma series, which was originally observed by Kuno (1950, Geological Society of America Bulletin) and suggested by his successors, and present a new working hypothesis including separation of supercritical fluids in mantle wedge. We show our recent sets of data of elemental partition between aqueous fluid and melt under high-temperature and high-pressure conditions and address our hypothesis.

Keywords: water, magma, high-pressure and high-temperature, chemical composition, synchrotron X-ray, subduction zone

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SVC052-11 Room:302 Time:May 26 17:00-17:15

A sulfur isotope perspective of fluid transport across subduction zones

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There is a broad consensus that mantle melting in subduction zones occurs as a result of transport of H2O (or H2O-rich components) from subducting slab to the mantle wedge. However, how and where this transport occurs is still one of the outstanding questions. We report here recent SIMS-based sulfur isotope data of pyrites in eclogites from the Western Gneiss Region (Norway: 700 - 850degreesC, 2 - 2.5 GPa; -3.4 - +2.8permil) and of olivine-hosted primitive undegassed melt inclusions from Galunggung (Indonesia: -3 - +5permil, 1000 - 2000ppm S), Krakatau (Indonesia: +1.6 - +8.7permil, 1200 ? 2400 ppm S), and Augustine (Alaska: +1 - +14permil, 2500 - 4700 ppm S). We argue that the observed sulfur isotopic compositions and mass balance considerations do not support the prevailing view of fluid transport at depths around 2.5 - 3 GPa, because the fluid released from eclogites (at 700degreesC; +2 - +8permil, 4000 ppm S) seems incapable of modifying the perceived sulfur isotopic composition of the mantle wedge (0permil, 250 ppm S) to the range observed in the primitive melt inclusions, if amounts of fluid transported to the wedge are constrained by trace element abundances of arc magmas. Our data suggests instead that fluid transport must occur at lower pressure and temperature conditions than previously thought; one possibility being subduction of the hydrated mantle wedge as a source of H2O-rich component for magma generation.

Keywords: subduction zones, magma genesis, fluid transport, sulfur isotopes

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SVC052-12 Room:302 Time:May 26 17:15-17:30

Hot fingers and arc crust evolution

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Subduction and arc magmatism are fundamental processes in the evolution of the Earth, because they play crucial roles in the present-day differentiation of earth's materials and are believed to be major sites of continental crust generation that have operated throughout geologic time. Processes of mantle melting and volcanic eruptions along subduction zones are often illustrated by the use of two-dimensional cross-section models of convergent margins. Initially, aqueous fluids released from the subducted oceanic sediments and crust rise into the mantle wedge, lowering the mantle solidus and stimulating magma generation and, ultimately, volcanism at the surface. In addition, the descent of the plate stirs the mantle, bringing a flux of warmer mantle material from greater depth, thermally reinforcing the melt generation process. I review here the structure of the mantle wedge and arc crust beneath the northeast (NE) Japan arc and the Izu-Bonin arc, respectively, and suggest that the third dimension, lying along the strike of the arc, is necessary to understand the actual production of magmas in subduction zones. These arcs are two of the best places in the world to understand the 3-D structure of the mantle wedge and arc crust. In this context, this 3-D structure indicates that magma productivity is not uniform along a volcanic arc. Information about 3D structures have come from independent studies of the mantle wedge and arc crust in the NE Japan and Izu-Bonin arcs, respectively, and common periodic structural variations, having wavelengths of 80-100 km, can be observed in both areas. Thus we suggest here that the 3D thermal structure of mantle wedge has a direct link to the 3D structure of arc crust via production of arc magma within the mantle wedge. The hot fingers models may play an important role in linking the 3D structures within the mantle wedge and overlying arc crust to volcanic eruptions at the surface.

Keywords: hot fingers, arc magmas, mantle wedge, crustal structure, primary magmas, rhyolite

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SVC052-13 Room:302 Time:May 26 17:30-17:45

Petrological characteristics of subarc mantle peridotites

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We would like to make a review of petrological works on the subarc mantle, which were pioneered by Kuno (1967) on peridotite xenoliths from the Megata volcano (Ichinomegata crater). After the works of Kuno, peridotite xenoliths from the Japanese island arcs, including those from the Megata volcano, have been extensively studied mainly by Japanese scientists. Petrological data on subarc xenoliths from the Philippines, Papua and Kamchatka have been accumulated to enable us to build a petrologic model of subarc mantle. Peridotite xenoliths from the SW Japan arc are representative of subarc mantle impacted by plume-related magmas. The Megata peridotite xenoliths, which are varied in degree of melting, may represent the backarc-side upper mantle of an arc, whereas the xenoliths from Avacha (Kamchatka) and Iraya (Philippines), which show high degree of melting and metasomatism, were from the upper mantle beneath a volcanic front. The degree of partial melting and metasomatic modification of peridotite is highest beneath the volcanic front, and decreases continent-ward. Backarc basin opening, if any, produced a series of depleted peridotite.

Keywords: peridotite xenoliths, subarc mantle, petrological characteristics, Hisashi Kuno, Ichinomegata, Japan arcs

Japan Geoscience Union Meeting 2011
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SVC052-14 Room:302 Time:May 26 17:45-18:00

Magma sources and isotopes

Ichiro Kaneoka[1*]

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A volcano is formed as an extrusion of magma on the surface. However, magma is not always extruded to the surface and often cooled down to form dykes or intrusive bodies under the surface. Magma is generally considered to be formed by partial melting of peridotites in te mantle and represent the physical and chemical circumstances of the site. High pressure and temperature experiments try to realize the magma and mineral compositions observed in the field assuming a starting material. Before about 1970, the starting material was generally adopted among some mantle xenoliths which might have been regarded to represent the chemical composition of the mantle. However, chemical compositions of volcanic rocks reflect not only the magmatic differentiation, but also the secondary effects such as contamination of crustal materials. It is difficult to identify such effects clearly only by the results of high pressure and temperature experiments and chemical compositions of volcanic rocks.

On the other hand, such isotopes as Sr, Nd, Pb, Hf, Os and noble gases which include radiogenic isotopes depend on the parent/daughter ratios and geological time, but they are independent of chemical processes. Hence, it is possible to clarify the difference of magma sources by using them, which cannot be separated by chemical compositions alone. At present, it is difficult to imagine to discuss the magma sources without taking such such isotopes into acoount. However, such situation was quite different several tens of years ago.

For example, in petrology it was quite common to assume some garnet-bearing peridotite and/or pyroxenite among mantle xenoliths as a source material for Hawaian volcanic rocks and tried to explain various types of volcanic rocks sed on high pressure and temperature experiments. The author clarified the difference between the olivine and pyroxene phenocrysts of Hawaiian volcanic rocks and mantle xenoliths in noble gas isotopes and argued that the source material of the Hawaiian magma should be originated in the deeper mantle compared to that as assumed in petrology (Kaneoka and Takaoka, 1980). Afterwards, it has been generally regarded that the source materilas of Hawaiian magmas are located in the deep mantle related to the mantle plume based on various kinds of isotope ratios. Without information of isotopes, it is difficult to discuss such issues.

Furthermore, in Japanese volcanic rocks, it is sometimes observed that the increase of their SiO2 contents correlate with those of 87Sr/86Sr ratios even in the same area. In such a case, it suggests an incorporation of materials with high 87Sr/86Sr ratios such as old crustal materials.

Thus, information of isotopes is inevitable to clarify the magma sources and their chemical circumstances nowadays, but it is not always easy to understand the meaning of their message. Hence, it is an important issue to understand them and how to utilize them properly.

Keywords: magma source, isotope, volcannic rock, chemical circumstance

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Extension and surface structure of Gaima lava plateau on the borderland between China and DPR Korea

Hiromitsu Taniguchi[1*], Jong Kim[2], Fukashi Maeno[3]

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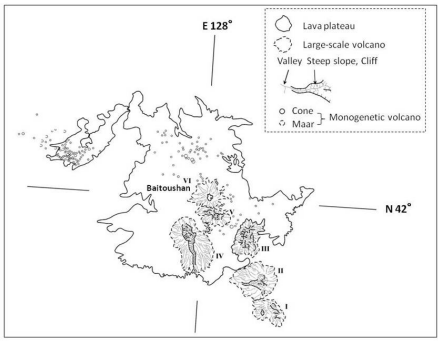
The Gaima lava plateau contains more than six large-scale volcanic edifices, including Baitoushan volcano, and more than 520 small-scale volcanoes are distributed over the plateau. We note that the volcanoes are arranged almost entirely along a NW strike, and the existence of a valley dividing each edifice into eastern and western components is common to these large-scale volcanic edifices. A global stress field having a maximum horizontal compression axis with a nearly NW strike might produce these characteristics.



Distribution of lava plateaus and volcanoes in the study region

Keywords: Gaima lava plateau, Baitoushan volcano, volcanic geology, satellite image

Japan Geoscience Union Meeting 2011
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SVC052-16 Room:302 Time:May 26 18:15-18:30

New views of the Moon: From Apollo to Kaguya

Tomoko Arai[1*]

[1]Chiba Institute of Technology

Rock samples returned from the Moon by Apollo and Luna missions provided us with basic understandings of the origin and evolution of Moon, Earth, and other rocky planets in the solar system. Yet, the global compositional data from subsequent orbital satellites (Galileo, Clementine, and Lunar Prospector) and analyses of lunar meteorites have revealed the diversity of the lunar surface composition and the nearside-farside asymmetry of the Moon. These data suggest that the lunar crustal evolution and thermal history should be by far more complex than that inferred from the Apollo samples which only represent the central nearside. KAGUYA (SELENE) mission now provides high-spacial and high-energy resolution remote sensing data on physical and chemical properties of the global Moon. The state-of-art data set, coupled with the latest results of lunar sample analyses, enable us to demonstrate the currently proposed model for a bimodal crustal evolution, and provide clues to answer the primary issues on lunar origin and evolution.

Keywords: Moon, Apollo missions, Kaguya mission, Lunar science