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

SVC048-01 Room:301B Time:May 22 09:30-09:45

Re-investigation of Holocene Eruptive History of Yotei Volcano, Southwest Hokkaido, Japan

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The latest eruption of Yotei volcano was occurred at the frank in approximately 10 ka. However, craters around the summit may be formed by Holocene activity because they have very good preserved land form. Therefore, we carried out geological and petrological investigations around the summit of Yotei volcano. Then, we can recognized eruptive deposits around the summit including Holocene activity and can fined a regularity of these activity in terms of changing crater with changing magma types and lava effusion more than 0.1 km3. Thus, we try to do long-term forecasting of eruption of Yotei volcano using these characteristics.

The stratigraphy of eruptive deposit around the summit of Yotei volcano is constructed on the basis of field occurrence and morphological investigation. Four eruptive crater groups are recognized, Summit, Hinangoya, Niseko and Kitayama ones in ascending order, from which six pyroclastic units (from S-6 to S-1 in ascending order) and five lava flow units, which flowed down to the foot of the volcano, erupted. Lava effusion occurred from the Hinangoya, Niseko and Kitayama craters. These activities were mainly Strombolian. 14C age of unit S-2 fallout deposit from the Kitayama-Takamine crater, was obtained as 4010+/-30 cal. yBP. The latest (S-1) and S-4 eruptions from Kitayama craters occurred in ~2,500 yBP and >5,000 yBP respectively, on the basis of estimated accumulation rate of soil layers.

Whole-rock chemistry of juvenile materials is distinct among four crater groups, indicating distinct magma system has been active beneath different craters. Eruptive deposits of Kitayama group do not show the evidences of long interval. Thus, it could be concluded that the Kitayama group started its activity from mid of Holocene. Eruptive volumes of each eruptive group except for the Summit crater group range from 0.1 to 0.18 km3. After the last magmatic eruption in 2.5 ka, there is no evidence of eruptions from the Kitayama group which erupted already more than 0.1 km3, indicating that activity of the group has finished. However, considering newly revealed eruption history of the summit area, it should be noted that next eruptive group with distinct magma system might start its activity from another crater. In that case, lava flow will flow down to towns of the western to northwestern foot of Yotei volcano depending on the position of the crater.

Keywords: Yotei volcano, Holocene, eruptive history, long-term forecasting of eruption

Japan Geoscience Union Meeting 2011
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SVC048-02 Room:301B Time:May 22 09:45-10:00

Emplacement processes inferred from micro-textures in Tokachi-ishizawa obsidian lava, Shirataki, northern Hokkaido

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Obsidian lava complex in Shirataki, Hokkaido, erupted at 2.2Ma and formed obsidian monogenetic volcanoes. A cross section of Tokachi-ishizawa obsidian lava (TI lava) in the complex is about 50 m in height and is stratigraphically observed from its flow bottom; pumice layer 1, obsidian layer, pumice layer 2, and rhyolite layer. The boundary between obsidian layer and pumice layer 1&2 is transitional. In this study, we precisely described the rock micro-textures of TI lava samples from obsidian layer to the rhyolite interior in order to understand the eruption processes of silicic obsidian lava.

TI lava samples are almost aphyric, composed of glasses ($>$98% in volume), rare plagioclase phenocryst (0.4-1.0 mm), plagioclase microlite ($<$0.2 mm), magnetite ($<$0.05 mm) and rare biotite ($<$0.01 mm). Magnetite can be classified into euhedral or subhedral group and acicular group, based on aspect ratio. We counted crystal number (N_v) of acicular magnetite by 3D counting method (Castro et al., 2003). The N_v value in all of the TI lava samples is high with 10^7-10^8 [number/cm^3]. On the other hand, euhedral magnetite (low aspect ratio) has obviously low crystallinity. Since N_v reflects the cooling history of crystallizing melt (Toramaru et al., 2008), this result indicates that acicular magnetite was probably crystallized by decompression like a degassing process, and thus magnetite in the groundmass was derived from two crystallization stages.

In the rhyolite layer, porosity is variable; bottom rhyolite layer sample (close to obsidian layer) has low porosity (2-3%), while interior rhyolite sample has high porosity (7-8%). Vesicles in rhyolite samples vary from spherical to high deformed shape. These porosity and vesicle shape variation imply difference in vesiculation processes in conduit and/or surface.

N_v and vesicle textures in TI lava indicate cooling history and vesiculation processes during conduit and surface flow. We intend to model the replacement processes that produced the obsidian-rhyolite internal structure of TI lava by viscous silicic magma.

Keywords: obsidian, rhyolite, Shirataki

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SVC048-03 Room:301B Time:May 22 10:00-10:15

Neptunian Eruptions and Woody Pumices in Greentuff

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Greentuff is composed of typical submarine volcaniclastics and a good target for understanding the mechanism of subaqueous volcanism. In recent years, a new eruption model named the Neptunian eruption is proposed for the felsic submarine explosive volcanism (Allen and McPhie, 2009). We found several deposits showing typical features of the Neptunian eruption along with woody pumices in Nishiwaga Town, Iwate Prefecture, northeast Japan. The new Neptunian eruption deposits found in Greentuff can be classified into 4 kinds of eruption column collapse deposits and 2 kinds of subaqueous suspension deposits.

Keywords: Greentuff, Neptunian Eruptions, Woody Pumice

Japan Geoscience Union Meeting 2011
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SVC048-04 Room:301B Time:May 22 10:15-10:30

Reexamination of Hachoudaira caldera eruption in Miyakejima Volcano

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Collapse caldera is a common volcanic structure in basaltic volcanoes. To make an effective forecasting of the volcanic activity, we must understand the variations of eruption activities based on the eruption history of the post-caldera period of many volcanoes.

Miyakejima Volcano formed Hachodaira Caldera in 2.5 ka BP. The tephra sequence of Hatchodaira Caldera Eruption has been divided into 5 units; scoria fall deposit (Hachodaira Scoria), thick volcanic ash deposit with aqutionary lapilli (Hachodaira Ash), lahar deposit (Hachodaira Lahar Deposit), scoria fall and explosion breccia deposit (Furumio Explosion Breccia), in ascending order. However, based on our outcrops observation, the Hatchodaira Caldera Eruption tephra is composed of Hachodaira Scoria and Hachodaira Ash, only. On the basis of radiocarbon dating and stratigraphical relation, the age of Hachodaira Scoria and Ash and Furumio Explosion Breccia is different for 600 years . Moreover it became clear that the flank fissure eruption occurred within about 100 years after the Hachodaira caldera formation.

Keywords: Miyakejima Volcano, Hachoudaira caldera, Frumio explosion breccia, Volcanic stratigraphy, tephrochronology, Radiocarbon dating

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SVC048-05 Room:301B Time:May 22 10:45-11:00

Sequential change of magma supply rate during the Hoei eruption, Fuji Volcano, Japan (AD 1707)

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The AD 1707 eruption of the volcano, known as Hoei eruption, is one of the most intensive eruptions of the volcano and caused severe damages in the downwind area. We reconstructed the sequence and change in mass discharge rate of the Hoei eruption from the detailed correlation between the timelines reestablished from historical documents and geological units.

The eruptive deposit was subdivided into 17 units on the basis of their facies with the mass of each unit established using isopach maps. However, from examination of historical documents, we only detected six obvious quiet intervals from historical documents. We thus defined an eruptive pulse as the period of continuous tephra fall divided by the obvious quiet interval. We then divided the course of the Hoei eruption into 3 stages on the basis of the pattern of eruptive pulses. The characteristics of the three stages are described as follows.

Stage I is characterized by quick firing of two energetic eruptive pulses (?25 km high column), with each of them showing intense outburst initially, followed by a decrease in intensity (?16 km high column). In this stage, silicic magma erupted in the early outburst phases and followed by mild phase of basaltic magma. Stage II consists of discrete firing of basaltic magma, resulting in the formation of a relatively low eruption column (?15 km high column). Stage III is principally characterized by sustained column activity of basaltic magma without a clear repose time. In stage III, the column height appears to be always above 13 km and at least three distinct active periods the column height is presumed to exceed 16 km.

The change in magma supply rate is summarized as follows. In initial silicic phase of stage I, the magma supply rate is high ($3.3x10^{11}$ kg/day) and then lowered to the average of the whole range of the eruption ($1.2x10^{11}$ kg/day). In stage II, the eruption become discrete and eruption rate decreased ($0.8x10^{11}$ kg/day). During the stage, intrusion of magma presumably formed Mt. Hoei. Thus, magma supply from depth might continue in same rate during this stage. In the stage III, the supply rate recovered close to the average rate ($1.1x10^{11}$kg/day) and maintained until sudden termination of the eruption.

The newly reconstructed sequence of mass discharge rate did not show any clear evidence of a downward tendency before the eruption ended. This observation could indicate that the mass flow was not principally controlled by excess pressure within the magma chamber.

Keywords: Fuji Volcano, Hoei Eruption, AD1707, Plinian, tephra, eruption column

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SVC048-06 Room:301B Time:May 22 11:00-11:15

Radiocarbon wiggle-matching for the age of the Hayakawa ignimbrite from Niigata Yakeyama Volcano

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Two wood trunks, one charred 75-year old and another not charred more than 199-year old, were collected from the Hayakawa ignimbrite erupted from Niigata Yakeyama Volcano. They were investigated by radiocarbon wiggle-matching method to determine the age of the eruption. The result is 1223-1242 calAD (95.4%), over 200 years younger than existing interpretations. The eruption including the Hayakawa ignimbrite was the largest of the volcano since the birth of 3,000 years ago. Co-ignimbrite fallout KGc ash has been found at many archaeological sites spreading out the eastern flanks of Myoko Volcano and the Takada Plain. Age obtained here will give a useful time constraint to archaeology, as well as volcanology of this area.

Keywords: Radiocarbon wiggle-matching, Hayakawa ignimbrite, Niigata Yakeyama Volcano, age of an eruption, buried wood

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SVC048-07 Room:301B Time:May 22 11:15-11:30

Activity of Koshikidake volcano in Kirishima volcanic complex

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The Kirishima volcanic complex has over 20 craters within a 25 km WNW?ESE and 15 km NNE?SSW expanse. It is known that volcanic activity in this complex predates the K-Ah tephra reported by Inoue (1988) and Imura (1992). The Kirishima volcanic complex consists of some types of volcanoes: those that eject lava, for example, Takachihonomine, and those that exhibit plinian eruptions, for example, Karakunidake. To clarify the differences between these types of volcanoes, we studied the Koshikidake volcano, one of the volcanoes in the Kirishima volcanic complex, that is of the type that ejects lava. We found approximately ten different tephra layers, collectively called the Koshikidake tephra, around this volcano. The first-stage tephra was indicative of five small vulcanian and scoria fall eruptions. Charcoal wood bottom of the Koshikidake tephra was dated to be 19,000 years BP. The sixth scoria fall was the largest tephra among all. In this case, over 1 to 2 km3 of lava flowed down the northern part of the volcano. Subsequent, recent stages were again indicative of repeated vulcanian and scoria fall eruptions. Traces of the largest vulcanian eruptions were observed in the recent tephra. Over the last 30,000 years, the Koshikidake volcano has ejected the greatest volume of products in the Kirishima volcanic complex. We estimated the activity period of Koshikidake volcano using the depositional rate of Ushinosune ash fall reported by Inoue (1988). The activity period and eruption volume are similar to those of the Takachihonomine volcano between 7600 and 7300 years ago.

Keywords: Kirishima volcano, Koshikidake, volcanic activity, age, volume of eruption

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SVC048-08 Room:301B Time:May 22 11:30-11:45

The hydrothermal alteration and contact metamorphism on the tonalite and volcanics of the Komahashi-Daini Seamount

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At the Komahashi-Daini Seamount (SMT) in the northern Kyushu-Palau Ridge (KPR), acidic plutonic rocks (tonalite) were recovered by research cruises of Japanese Geodynamics Project (GDP) during 1970's and R/V Tansei-Maru, Ocean Research institute, during 1990's. Haraguchi et al. (2003) considered that this tonalite was produced by fractional crystallization of the basaltic magma during the arc volcanism before spreading of the Shikoku backarc basin. This study was selected flesh samples. However, many altered plutonic rocks were recovered with fresh ones during these cruises. Volcanic rocks were recovered with plutonic rocks. These volcanics exhibit highly alteration. In this study, we research these highly altered plutonics and volcanics by petrographical, geochemical and mineralogical processes using chemical analysis by electron microprobe analyses (EPMA) and identification by X-ray diffraction (XRD). And we consider alteration processes during intrusion of acidic plutonic body.

Plutonic rocks from the Komahashi-Daini SMT are divided into hornblende- and biotite-hornblende tonalite. Highly altered tonalite were recovered with both tonalites. Alteration is prominent in colored minerals. Many colored minerals are replaced into chlorite identified by EPMA and XRD analyses. Fresh tonalites not altered of colored mineral are about 1/10 amount of all recovered plutonic rocks. Plagioclase resist from alteration compared to colored mineral, however, albitization is observed in some high-altered tonalites. K-feldspar is rare in altered tonalites.

Volcanic rocks were recovered from all sites dredged plutonic rocks, and exhibit highly alteration. The alteration ratio of these volcanics is from surviving to modifying of primary igneous textures. Plagioclase phenocrysts exhibit albitization, and albite and chlorite are identified, similar to plutonic rocks. Quartz is also identified by XRD and EPMA analyses. These secondary minerals are difficult to identify by microscope observation. We considered that the analyses of mineral composition are the effective tools of identification of fine mineral phases.

The mineral assemblage of chlorite, albite and quartz in the altered plutonic and volcanic rocks indicate alteration under 150 to 200C or higher than this temperature. We considered this alteration was caused by hydrothermal circulation between intrusive rock and host rocks. We also considered that the volcanic rocks had effected under contact metamorphism because these volcanics exhibits prominent re-crystallization.

Te bulk composition of volcanics exhibit 54-64 wt% of SiO_2, and we assumed that the prominent re-movement of alteration-resistant elements. These volcanics exhibit similar chemical characteristics to tonalites, especially, HFSE exhibit similar depleted contents and ratios. The other volcanics from the northern KPR, considered to products of rifting volcanism associated with spreading of the Shikoku Basin, exhibit enriched composition, and these enriched volcanics is not found from arc volcanism before rifting activity. Therefore, we considered that volcanics from the Komahashi-Daini SMT is the products of arc volcanism before rifting activity, assumed to earliest stage volcanics of the KPR. The earliest stage of arc volcanism in the KPR was only reported from the Palau Islands. Therefore, this volcanics is important to indicate the environment of early stage arc volcanism in the KPR. Hydrothermal alteration textures observed in the tonalites and volcanics at the Komahashi-Daini SMT is also important because these textures indicate the existence of hydrothermal activities during the early stage of arc volcanism in the proto-IBM arc and possibility of hydrothermal ore depositions in the KPR.

Keywords: Kyushu-Palau Ridge, Arc volcanism, Acidic plutonic body, Secondary mineral assemblage, Hydrothermal alteration, Contact metamorphism

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SVC048-09 Room:301B Time:May 22 11:45-12:00

One dimensional model on crustal melting by injections of hot magmas into continental crust

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Crustal melting by injection of hot magmas is an important process for magma genesis in continental crust. Most magmas in arc magmatism in continental crust like Japan are probably produced by crustal melting. An aim of this study is to understand constraints of composition, amount, and generation timescale of magmas generated by crustal melting due to hot magma injections. We report calculation results of an one-dimensional physical model on crustal melting where repeated injections of hot magmas into crust produce magmas.

The model of crustal melting by Koyaguchi and Kaneko (2000) is followed. When a crust is melted by a hot magma injected into a crust, large heat flux from the convecting injected magma rapidly melts the overlying crust up to the degree of partial melting large enough to convect (~100 yr timescale). After that, the injected magma and convecting region of partially-molten crust decrease in temperature and melt fraction, and hence cease to convect for melt fraction to decrease down to the critical melt fraction where the mixture of solid and liquid cannot convect. At this stage, heat transfer becomes only conductive and slow (>10,000 yr). When a new injection of a hot magma occurs, the above processes repeat. It is considered that hot magmas repeatedly inject at the same level and that no segregation between liquid and crystal occurs in our model. Additionally, effects of water in the hot magma were also taken into account. The hydrous hot magma melts the crust, solidifies itself, becomes saturated in water, and releases free water into the overlying crust.

For calculation, the relationship between temperature, composition, and melt fraction of the crust was formulated on the basis of the melting experiments and MELTS program. We calculated melt amount and degree of partial melting for 300 ky in our model under constant initial conditions of initial temperature (1250 deg.C), composition except water (basaltic), and injection thickness (50 m) of injected hot magmas and temperature (0 deg.C of surface temperature and 20 deg.C/km of temperature gradient in the crust) and water concentration (2wt%) of the crust. Injection depth (0.25-1.0 GPas), the critical melt fraction of convection-nonconvection (0.5-1.0), injection rate (2-20 m3/m2ky) and water content (2-12 wt%) of the injected hot magma, and crustal composition (basaltic-dacitic) were varied as parameters in our calculations.

Important results of the calculations are as follows.

(1) Crustal melting efficiently proceeds by convection. Amount of crustal melt in convection case is more than 20 times to that in non-convection case.

(2) In convection case, the region that undergo convection by melting up to high degree of partial melting has mafic melt almost with the critical melt fraction for a long time after convection stops. Its overlying crust has silicic melt with low degree of partial melting.

(3) Injection rate of the hot magma is the most important parameter in this system. Larger injection rate increases amount of crustal melt. On crustal melt composition, amounts of mafic and silicic melts are comparative for 20-30 thousand years after beginning of the injection, but after that mafic melt becomes dominant. This temporal change of melt composition proceeds more rapidly in larger injection rate.

(4) Water content of the hot magma hardly affects amount and composition of melt, except for hot magma with extremely larger water content.

The above results is applied to the natural igneous system. Generation of comparative amount of mafic and silicic magmas in 20-30 thousand years after beginning of hot magma injection may present magmatism of large pyroclastic eruption cycles like Aso volcano which occur in 20-30 years interval. On the other hand, the situation that partial molten region with the critical melt fraction, which is porphyritic mafic magma, is dominant after 50 thousand years may be interpreted as porphyritic andesitic magmatism of magma in NE Japan.

Keywords: crustal melting, continental crust, physical model, heat transfer

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SVC048-10 Room:301B Time:May 22 12:00-12:15

Re-examination of upper limit viscosity of eruptible magmas

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Magma eruptability is an important concept in assessment for eruptive activity of long-dormant volcanoes. The magma eruptability is dominantly controlled by magma viscosity, because timescale of magma movement is controlled in the balance between viscous resistance of magma and driving forces. Using a compilation of magmatic properties such as melt composition, melt water content, temperature, and phenocryst content, the pre-eruptive magma viscosities under chamber condition are calculated for 83 erupted magmas. The studied basaltic to rhyolitic magmas have pre-eruptive viscosities in the range 10^1 to 10^8 Pa s. Although bulk SiO_2 content is commonly used as a qualitative measure of pre-eruptive magma viscosity, the results indicate that bulk SiO_2 content shows a weak correlation with magma viscosity, due to the effect of phenocrysts. By using estimated viscosities, a hypothesis of two-fold upper viscosity limits (dike-propagation and magma-extrusion limits for preeruptive viscosity of eruptible magmas, Takeuchi, 2004, Geology) is examined. Most of the calculated viscosities fall below ca. 10^6 Pa s, which is consistent with the model-based estimate for the dike propagation limit. This study describes 20 examples of highly viscous magma that exceeds the dike propagation limit, and 9 of these magmas erupted following the precursory eruption of less-viscous magma. Two possible mechanisms generating the less-viscous magmas are considered: 1) generation of a remobilized magma through interaction between a high-temperature and a low-temperature highly viscous magma, 2) segregation of interstitial rhyolitic melt from highly viscous magma (crystal mush). Although the hypothesis requires further examination, two-fold viscosity limits operate, to some extent, as a universal control of magma eruptibility.

Keywords: magma viscosity, magma eruptibility, dike propagation, pre-eruptive condition

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SVC048-11 Room:301B Time:May 22 12:15-12:30

GEO Grid volcanic gravity flow simulation system: A case study on the 2011 eruption at Shinmoedake, Kirishima Volcano

Shinji Takarada[1*], Shinsuke Kodama[1], Takahiro Yamamoto[1], Minoru Urai[1]

[1]AIST

GEO Grid is an E-Infrastructure to accelerate GEO sciences related information retrieval, storage and processing based on the concept of virtual integration of all data related to earth observation, with certain access management. The GEO Grid system using a set of Grid and Web service technologies would be easy to handle by the end users. Numerical simulation of volcanic gravity flows on volcanoes is one of the major applications of the GEO Grid project. A web-based GIS system combining various types of information with real-time numerical simulations are necessary for the next generation of volcanic hazard mapping system. Volcanic gravity flow simulations using the energy cone model are currently implemented on the GEO Grid system. An interactive user interface to evaluate the probability of an area to be affected by volcanic gravity flows is available on the GEO Grid website. The simulation results could be downloaded as shape or KML files. We applied GEO Grid simulation system on the recent 2011 eruption at Shinmoedake, Kirishima Volcano, Japan. This system was quite useful to evaluate the potential danger zone in this area. The best-fit parameters of the pyroclastic flows were H/L=0.2-0.3 and the Hc (column collapse height) =300m. The GEO Grid simulation system is available at: http://volcano.geogrid.org/applications/energycone/. The ASTER Global DEM (G-DEM, 30m resolution), STRM-3 (90m) and GSI 10m DEM are planned to be installed on the GEO Grid system. The energy cone simulation on the GEO Grid system could be applied to other geological hazards such as debris avalanches and landslides. The gravity flow simulation is open to all scientists in the world.

Keywords: GEO Grid, pyroclastic flow, volcano, simulation, Kirishima, hazard map

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

SVC048-12 Room:301B Time:May 22 12:30-12:45

A study on a methodology of volcanic scenario analysis applying FEP analysis: Development of deductive inferring method

Makoto Murakami[1*], Makoto Kawamura[2], Hitoshi Makino[3], Nobuo Geshi[4], Teruki Oikawa[4], Takuya Nishimura[5], Koji Umeda[3], Hisashi Sasaki[6], Toshihiro Seo[3], Ohi Takao[7]

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A volcanic eruption scenario is a hypothetical volcanic activity prepared for planning or drill of evacuation, rescue, and restoration from the disaster. Given this goal, scenario should have the following entities; location, time, duration, scale of eruption, eruption style and extrusion rates, etc. Current scenario building techniques for volcanic eruptions are depending on empirical methods based on past events of targeted volcano or the world's volcanic activity of similar nature. The scenario will be more efficient if we can include contribution from deductive thinking method assuming that whole volcanic processes are composed of many elementary physical and chemical phenomena. Because a volcanic process are composed of a series of elementary processes of chemical and physical nature, it may be possible to infer the sequential pathway of volcanic eruption process to some extent. The next stage of the process may be guessed starting from the state just before it by deductive reasoning. We will discuss the result of our feasibility study to demonstrate such a deductive inferring method is possible in volcanic scenario building.

Keywords: Volcanic Scenario, Volcanic Eruption Prediction, Disaster Mitigation, FEP: Feature, Event, Process, FEP Analysis

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SVC048-P01 Room:Convention Hall Time:May 22 14:00-16:30

A study on a methodology of volcanic scenario analysis applying FEP analysis - A case study -

Makoto Murakami[1], Makoto Kawamura[2*], Hitoshi Makino[3], Nobuo Geshi[4], Teruki Oikawa[4], Takuya Nishimura[5], Koji Umeda[3], Hisashi Sasaki[6], Toshihiro Seo[3], Takao Ohi[7]

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The prediction technique of the volcanism is requested from the viewpoint of disaster prevention now. The prediction method using the volcanic scenario has been paid to attention. The purpose of this study is to develop the methodology of the volcanic scenario construction that the progress of the volcanic activity is predictable by progressively applying the FEP analysis methodology in the research of HLW geological disposal to the volcanic activity. A basic concept is as follows. We resolve the phenomena to compose the volcanic activity to the single-process referring to past volcanic eruptions. The single-process is arranged to the logical function theory. And, the development of volcanic scenarios is expressed as a chain of the functions. As a result, we developed adaptable volcano scenarios to the purpose. Moreover, it could be expected that the observations are made more effective by feeding back this methodology to the field survey.

Keywords: Volcanic Scenario, FEP: Feature, Event, Process, FEP Analysis, Single-process, Function, Matrix

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

SVC048-P02 Room:Convention Hall Time:May 22 14:00-16:30

Dilatational crustal deformation preceding earthquake swarm activities in Hakone volcano

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Hot springs Research Institute (HSRI) has been carrying out seismic observation in and around Hakone volcano since 1968. In early times of the observation hypocenter determination was performed using S-P times read from seismograms recorded on feeding paper. It is a bit surprising to see that most of the hypocenters were determined just beneath near Owakudani in the northern part of central cones. However, having re-examined hypocenters of swarm earthquakes in 1970s using the current method of hypocenter determination, Honda et al. (2011) found out that seismic activities actually had occurred in a wider region not much different from recent activities. The seismic activity in Hakone caldera had been quiet in 1970s. Then, after rather notable activities in mid 1980s and in mid 1990s a most remarkable activity occurred in June through October in 2001 accompanying crustal deformation. Since the greatest activity in recent several decades, it is said that the over all seismicity as well as the active areas in Hakone caldera has increased (Harada et al., 2009). Having de-clustered the earthquake catalogue of HSRI, we examine characteristics of both clustered and de-clustered activities (here we call the former swarm activity and the latter background activity), noting differences in temporal changes and in spatial distributions between those two types of activities. We especially pay attention relationship between appearance of crustal deformations in 2001, 2006 and 2008-2009 and changes in both types of the activity.

From the Gutenberg-Richter diagrams it is considered that almost all earthquakes equal to or larger than M0.1 have been detected over the whole period of the examination and number of earthquakes after 2001 is more than ten times compared to that before 2000. The increase in the occurrence rate after 2001 for both swarm and background activities is clearly seen from the curves depicting cumulative number of earthquakes. However, it should be noted that apparent changes of the occurrence rate differs significantly depending on the cut-off magnitude (Mc). Dilatational crustal deformations have been observed three times by the GEONET of the Geospatial Information Authority of Japan since 2001. Although the associated changes in the occurrence rate of earthquakes are clearly seen in the catalogue of Mc 0.8, they are hardly seen in the catalogue of Mc 0.1. A notable feature is a tendency which rise of the increasing rate in the background activity and occurrence of the clustered activity are delayed to the start of the dilatational crustal deformation. This indicates that occurrence of swarm activity could be forecasted before its occurrence by noting crustal observation. It seems that no direct relationship exists between the occurrence of swarm activity and progress in the crustal deformation. This is a notable difference from the swarm activity in the east-off Izu peninsula. The b value for swarm activities is larger than that for background activities, meaning that the former activity includes relatively more small earthquakes. It implies that swarm earthquakes occupy only a small part of the energy released by the activity of Hakone volcano. The feature is also inferred from the occurrence mechanism of swarm activities suggested by Yukutake et al. (2010). We would like to note here that there is a clear difference between the swarm and background activities in the spatial distribution, where the latter is especially high in the southern part of central cones.

Keywords: Hakone volcano, swarm activity, background activity, b value, crustal deformation, forecasting

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

SVC048-P03 Room:Convention Hall Time:May 22 14:00-16:30

Origin of two types of mafic inclusions for Kurodake volcano, Taisetsu volcanic group, central Hokkaido, Japan

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Kurodake volcano was formed about 0.2 Ma with andesitic lava flows. The lava flows contain a number of mafic inclusions. Two types of mafic inclusions, referred to as Fine-type and Coarse-type, are distinguished by size of microphenocrysts. In this study, we present origins of the two types of mafic inclusions.

Host lavas display a wide rage of plagioclase An content (An = 40-90). In the Fine-type mafic inclusions, the An content of plagioclase microphenocrysts has a peak between 70 and 80, which correspond to high An content of plagioclase phenocrysts in the host lavas. On the other hand, in the Coarse-type mafic inclusions, that of plagioclase microphenocrysts has a peak between 45 and 55, which correspond to low An content of plagioclase phenocrysts in the host lavas. Thus, the Fine-type is derived from foam layer of mafic end-member magma, whereas, the Coarse-type is formed by undercooling around margin of silicic magma chamber.

Keywords: mafic inclusion, magma mixing, plagioclase

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

SVC048-P04 Room:Convention Hall Time:May 22 14:00-16:30

Description of the deposits of a historical small eruption in the Yatsugatake Volcano, Japan, and their significance

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The Yatsugatake Volcanic Chain, located in central Japan, has many eruptive centers and trends north˜south over a distance of 21 km. Its activity started about 0.5 Ma, but many eruptive events have occurred in the surrounding area for more than 1 million years (*e.g.*, Nishiki *et al.*, 2007). Age data for each eruptive event are gradually accumulating, but few studies have investigated the younger period, in particular the Holocene.

Yokodake, located at the north end of the volcanic chain, had at least two eruptive events at about 2.4 ka and between 0.9 and 0.7 ka (Okuno, 1994). In the latter case, the Hacchodaira lava flowed from the south flank of Yokodake (Okuno, 1995).

We therefore performed a field survey in Northern Yatsugatake area to clarify whether eruptions occurred in other areas and to determine whether volcanic activity in 887 or 888 A.D. triggered the sector collapse in the Inagodake area.

We observed white volcanic ash deposits of silt-size grains in a few localities from Mt. Nyu to Sirakoma Pond. The deposits were 2.5˜8 cm thick and positioned between the upper black soil and lower brown soil. The ash contained two pyroxenes, plagioclase, quartz, hornblende, and oxyhornblende phenocrysts. The refractive indices of the oxyhornblende phenocrysts in every deposit were between 1.733 and 1.752.

The ^{14}C (AMS) ages of the soil deposits covered with the white ash ranged from 415 to 585 years BP (Libby Age), *i.e.*, calendar years 1320˜1465 A.D. (68.2% probability).

Because they had similar characteristics, we believe that all of the deposits recognized in this study were the same product.

The white ash may be the product of a small phreatic explosion because it lacks any fresh or vesicle grains. The distribution suggests that the source crater of this ash was between Mugikusa Pass and Mt. Nyu. The presence of oxyhornblende phenocrysts in the ash means that the source crater of this ash is in the distribution area of the Inagodake lava, which includes oxyhornblende phenocrysts.

We do not believe that any relationship exists between the eruption of this ash and the sector collapse that occurred in 887 or 888 A.D. because the ash is younger than the sector collapse. Nevertheless, determining more characteristics of the ash, such as the location of the source crater, is important for reconstructing the igneous activities in this area.

This study was subsidized by Paleo Labo Co. Ltd., Japan.

Keywords: Yatsugatake Volcanic Chain, historical eruption, volcanic ash, AMS dating

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

SVC048-P05 Room:Convention Hall Time:May 22 14:00-16:30

Stratigraphy and Lithlogic Features of the Borehole Core from the Onioshidashi Observation Well, Asama Volcano

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Stratigraphy and Lithlogic characteristics of the borehole core from the Onioshidashi observation well located at the northern foot of the Asama volcano were described. The total depth of the boring reached 201m from the surface. Based on lithologic features, the core consists of three stratigraphic groups. The upper part(0m-72.4m in depth) mainly consist of andesitic pyroclastic flow deposits. The middle part(72.4m-98.3m in depth) mainly consist of andestic lahar deposits including dacitic lava fragments and pumice. The lower part(98.3m-201m in depth) consist of mafic andesitic lahar and pyroclastic flow deposits, and additional thin air fall pumice layers. Ohkuwa debris avalanche deposit that formed in the late stage of Kurofu volcano and pumice flow deposits associated with plinian eruptions of Hotokeiwa volcano are absent. K-Ah tephra (ca.7.3ka) was found in a soil layer depth in 51.3m. Pyroclastic flows near this horizon are significant to clarify the eruption style of initial stage of Maekake volcano.

Keywords: Borehole core, Asama volcano, Eruptive History, Lahar, Pyroclastic flow, K-Ah tephra

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

SVC048-P06 Room:Convention Hall Time:May 22 14:00-16:30

K-Ar ages of post-caldera volcanic products from Aso volcano, central Kyushu, Japan

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The geochronological and geochemical data of post-caldera volcanic products are expected to provide us key information about magmatic evolution process and magma plumbing system after the formation of caldera.

Aso volcano, situated in central Kyushu, produced four gigantic caldera-forming pyroclastic eruptions (Aso-1 to Aso-4) between 270 and 90 ka. On the other hand, the post-caldera volcanism (after 90 ka) is characterized by multiple effusive eruptions from several vents, and formed the present central cones inside of caldera (Ono and Watanabe, 1985). The drastic change of eruption style during caldera formation probably reflects the change of magma-plumbing system beneath caldera. To clarify the detailed temporal change of the magma-plumbing system, the absolute age dating of volcanic products is necessary. We, therefore, determined the K-Ar ages for several lava units of the post-caldera volcanic products from Aso volcano.

The argon isotopic ratio was measured using a noble-gas mass spectrometer MS-IV (modified VG-5400) in the Geochemical Research Center, Graduate School of Science, The University of Tokyo. In this study, the radiogenic 40Ar contents of samples were determined by using the sensitivity method. In this method, the unknown concentration of 40Ar contained in a sample is determined by comparing its 40Ar peak intensity with that of a standard air sample whose 40Ar concentration is known. The isotopic composition of the initial 40Ar/36Ar ratio of the sample that differs from the modern atmospheric value of 296 was determined with correction of mass-dependent fractionation based on measured 38Ar/36Ar ratio (Takaoka et al., 1989).

K-Ar ages of the following lava units were obtained.

1) Tateno lava: 60-50 ka, 2) Matsunoki lava: 80-70 ka, 3) Okamadoyama lava: 70-60 ka, 4) Hakusui lava: 40-30 ka, 5) Akase lava: 40-30 ka, 6) Otogase lava: 20-10 ka, 7) Eboshidake lava: 40-30 ka, 8) Karisako lava: 40-30 ka, 9) Narao-dake lava: 20-10 ka.

These obtained eruption ages are quite consistent with stratigraphic succession which was established by the previous geological studies (e.g., Ono and Watanabe, 1985).

Keywords: K-Ar age dating, unspiked method, Aso, post-caldera volcanism, central cones

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

SVC048-P07 Room:Convention Hall Time:May 22 14:00-16:30

Volcanio stratigraphy on the central part of Kozushima Volcano, based on JMA volcano-observation drilling core

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Volcano stratigraphy of Kozushima Volcano, based on the JMA boring core

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

SVC048-P08 Room:Convention Hall Time:May 22 14:00-16:30

Sr isotopic ratios of volcanic rocks from Nekodake in Aso area, Central Kyushu

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Nekodake is located in eastern side of Aso central volcanic cones in Aso caldera, and consists of volcanic products. Its volcanic products are lava, agglutinates, pyroclastic rocks and dykes. Nekodake is a volcano, because dykes radiating from center of Nekodake and each unit of lava flows distribute in parallel with the slopes. Although Nekodake was recognize as one part of Aso central volcanic cones, it was defined as an older volcanic body, because the characteristics of bulk major elements are different and it is covered Aso-3 pyroclastic deposites (Ono and Watanabe, 1985). K-Ar datings show 0.15-0.14 Ma and 0.11-0.09 Ma of Nekodake volcanic rocks (Itaya *et al.*, 1984 and Matsumoto *et al.*, 1991, respectively). These ages were between Aso-2 and Aso-4, but Shinmura *et al.* (2010) reported that bulk rock Sr isotopic ratios and REE contents of Nekodake volcanic rocks were clearly different of volcanic products in caldera forming and inter caldera stages.

In this study, volcanic rocks were sampled at Nekodake widely and bulk rock chemical and isotopic data were determined. Range of SiO_2 content was 53-60 wt. % and of $^{87}Sr/^{86}Sr$ was 0.7041-0.7047. Sr isotopic ratios of Nekodake was higher than those of Aso pyroclastic deposites (0.7040-0.7042) (Hunter, 1998), and was higher than those of volcanic rocks of post caldera and pre caldera (Shinmura et al., 2010). Crustal xenoliths consists of quartz and feldspar are included in volcanic rocks of Nekodake. Sr isotopic ratios of these xenoliths were 0.7046-0.7055 and higher than those of Nekodake volcanic rocks. One of the xenolith shows inter-finger structure with magma, and this is an evidence of magma process assimilating of crustal material.

Star mark in Fig 1 shows the data that is the most lower Sr isotopic ratio, is basalt which was lower defferentiated. Most of the data distribute along the line from the star mark to the area of higher Sr ratios as xenolith's (0.7046-0.7055). This shows that the original magma which component was as star mark assimilated crustal material, and the variety of Sr isotopic ratios were depend on the assimilation process.

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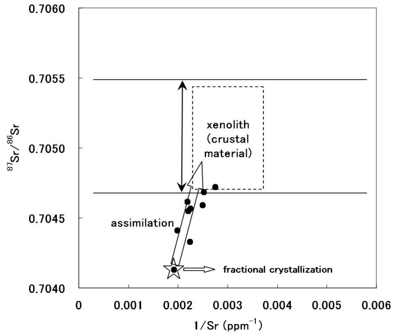

Fig 1. 1/Sr vs. $^{87}Sr/^{86}Sr$ diagram for the Nekodake volcanic rocks.

Keywords: Nekodake, Aso, Sr isotopic ratio, mixing of crustal materials, xenolith

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

SVC048-P09 Room:Convention Hall Time:May 22 14:00-16:30

Occurrence and microtexture of the mafic obsidian from the late Miocene basaltic plateau in the Primorye region, Russia

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We introduce the mafic obsidian consisting of andesitic glass (SiO_2=56-59wt.%) without microlites (more than a few micrometers in size), which are found in the chilled margin of pillow lavas and hyaloclastites and of thin lava flows from the late Miocene basaltic plateau (Shkotovo plateau and Shfan plateau) in the Primorye region, Far East Russia (Popov et al.,2009). The chilled margins of mafic obsidian are more than 1 cm in thickness in their outcrops commonly, and they are found as cobbles with several to 10 cm in size. Furthermore the chilled part extends to the pillow interior to produce the large mafic obsidian. The mafic obsidians are black, dark-blue, and deep gray in color. These features show that the mafic magmas with low viscosity and high temperature were transformed into andesitic glasses under super cooling condition. It is possible to attain the high super cooling condition if the mafic magmas were erupted under the ice sheet during the ice age of 14-13 Ma.

Keywords: mafic obsidian, basaltic plateau, Far East Russia, pillow lava

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

SVC048-P10 Room:Convention Hall Time:May 22 14:00-16:30

Textural characterisation of Volcanic Debris Avalanche Deposit matrix through field and SEM study

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Volcanic Debris Avalanches (VDA) constitute a major hazard in volcanic areas, especially as it can travel long run-out distance unlike non-volcanic landslide. To understand mechanisms of emplacement of VDAs is thus essential in view of hazard mitigation.

Until now, scientist community tend to agree on the importance of the matrix in VDAs transport. However, it stays unclear how matrix form and in which manner it helps VDAs transport. Internal deformation, stresses repartition, and how the matrix acts to allow such long distance of transport remain obscure. Similarly, does the matrix behave as laminar or turbulent flow or is it a combination of both processes?

To answer those fundamental questions, we propose to use field and SEM data. Outcrop and micro-scale structures such as striation, tension gashes, hackle fractures etc can give some insights onto matrix formation and role in VDAs emplacement.

Keywords: Volcanic Debris Avalanches, Matrix, Structural characteristics, Emplacement mechanisms