©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P01 Room:Poster Time:May 1 18:15-19:30

Morphology of microlite -projections of plagioclase microlite-

SANO, Kyohei[1*] ; TORAMARU, Atsushi[2] ; WADA, Keiji[3]

[1]Department of Earth and Planetary Sciences, Graduate School of Sciences, Kyushu University, [2]Department of Earth and Planetary Sciences, Faculty of Sciences, Kyushu University, [3]Hokkaido University of Education at Asahikawa

At Tokachi-Ishizawa (TI) rhyolite lava, Shirataki, Hokkaido, northern part of Japan, the interior structure transition can be observed, from the outer obsidian layer to the inner rhyolite layer. Thus TI lava is an appropriate target field for correlating textural characteristics with lava interior structure. In order to obtain insights into the magma ascent and outgassing process of viscous magma, we have analyzed oxide microlites of TI rhyolite lava, suggesting that dominant outgassing process is ductile permeable development (Sano et al.,2013 JpGU meeting). However, we have not examined the morphology of microlite. Morphology of crystal is considered to reflect the effective undercooling of the melt and provide the constraint for ascent process and water exsolution processes. In this study, we focused on the morphology of microlites, especially projections of plagioclase microlites. The projections mean localized growth of crystal from plagioclase surface.

In Shirataki, aphyric rhyolite lavas erupted ca. 2.2Ma and composed of 10 flow units. The TI lava is about 50 m in height and stratigraphic sequences from the bottom are a obsidian layer region, a boundary bounded region of obsidian and rhyolite, and rhyolite layer region. The obsidian layer region consists of a single vesicle-free obsidian about 7 m high. The rhyolite layer region consists of rhyolite layers with variable vesicularity, crystallinity and characteristic scales in layer thickness. The boundary banded region, which is located between the obsidian and rhyolite regions, consists of thin obsidian ($<$10mm in width) and rhyolite. In this study, we define the obsidian and rhyolite based on the differences in appearance of hand specimens and rock texture. Rhyolite has perlitic cracks in the glass and contains some amounts of crystalline materials, namely, spherulite and lithophysae. In boundary banded region, the fraction of obsidian decreases toward rhyolite layer region.

From the examination by scanning electron microscope (SEM) for thin sections from obsidian layer region, boundary banded region and rhyolite layer region, we found the projection texture in all samples. We measured projection length and number density (Nv) of plagioclase microlites for obsidian and rhyolite layer regions. The measurement results show that plagioclase microlites in obsidian and rhyolite layer regions indicate the similar number density. Nv for obsidian layer region is $1.8\times10^{11} - 3.5\times10^{11}$ [/m^3] and $8.2\times10^{10} - 3.0\times10^{11}$ [/m^3] for rhyolite layer region, respectively. However, the length of projection is remarkably different between two regions. The mean values are 2.3 μm in obsidian layer region, and 8.7 μm in rhyolite layer region. The transition of mean length can be observed in boundary layer region.

Since the difference of projection length reflects the growth rate (G [m/s]) and growth time (t [s]) according to the theory of crystal growth (Keith and Padden, 1963; Lofgren, 1971; Rao, 2002), we can estimate the degree of effective undercooling at the formation time of projections. Under the assumption that G is constant for the time, the length of projection can be given by Gdt. Assuming the constant growth rate and growth time, the difference in projection lengths indicate that in growth rate, namely, the undercooling. Using experimental values for growth rate and undercooling, it is found that the rhyolite layer region experiences higher undercooling than obsidian layer region by 30 $-$ 70 K. The projection can be formed after the nucleation of plagioclase microlite, which indicate the similar number density in obsidian and rhyolite layer region. Thus projections reflect the different undercooling after the nucleation of microlites. Based on the quantitative analysis of crystal morphology of microlites, we can obtain the insights into the magma ascent process that rhyolite layer region experienced higher undercooling than obsidian layer region.

Keywords: textural analysis, obsidian, rhyolite, lava, Shirataki

Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)
©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P02 Room:Poster Time:May 1 18:15-19:30

Differentiation process of arc magmas revealed by principal component analysis on trace element composition

UEKI, Kenta[1*]

[1]Volcanic Fluid Research Center, Tokyo Institute of Technology

Chemical composition of magma can be used to address state of the magmatic system and the processes during magma generation, ascendent and eruption. Various processes from the mantle to the crust in various pressure, temperature and chemical composition modify magma composition. Consequently, bulk chemical composition of erupted magma represents a sum of these processes.

Differentiation in terms of major element composition is controlled by non-linear thermodynamic relation. Major element composition of magma is modified by temperature, pressure and H2O content dependent saturation states of mineral phases, and partition between melt phase and mineral phases. In this sense, major element composition can be a proxy of physical state during magma generation and ascendent. However, the non-linarlity of major element processes and a small degree of freedom in compositional space prevent us from decomposition of processes that have derived compositional variation in terms of major element.

On the other hand, partition of trace elements between melt and mineral phase can be modeled with relatively simple equation, and can be considered as a linear process. Consequently, trace element composition of erupted magma represents a simple sum of a melting and differentiation processes. Trace element can be a tracer of the specific phase or reaction, because partition coefficients between various minerals melt show wide range of variation. Therefore, trace element can be used as a proxy of a specific chemical mass reaction process during magma generation and ascendent. In addition, trace element composition shows a large degree of freedom. Therefore, it is expected that nature and the number of processes during magma generation and ascendent can be decomposed by analyzing trace element composition of volcanic rock using multivariate statistics.

In this study, principal component analysis is used to analyze compositional variation of volcanic rocks in Northeastern Japan Arc.

Analysis based on a series of volcanic rocks from single volcanic activity has shown that the differentiation process and/or mantle melting process beneath each volcano (crystal fractionation and magma mixing) can be decomposed by using principal component analysis on trace element compositions. Consistent relationship between the trace element principal components, major element composition, and petrological information such as mineral composition is derived from the analysis.

In order to illustrate the differentiation process in terms of large scale spatial and compositional range, 262 samples from 17 different volcanoes in the Sengan region, northeastern Japan are analyzed with principal component analysis. Result of the analysis clearly demonstrates that differentiation processes in the arc crust, are the primary controlling factor to derive compositional variation of arc magmas. Only three principal components account for the compositional variation of 262 samples. It is estimated the three principal components represent magma mixing, relatively high pressure olivine fractionation, and relatively shallower pressure plagioclase differentiation, respectively. No strong mantle signature is identified by the analysis. This result shows intermediate-felsic magmas (SiO2>60 wt. %) can only be derived through magma mixing, not by crystal fractionation.

Keywords: volcanic rock, arc magma, crystal fractionation, magma mixing, trace element

Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)
©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P03 Room:Poster Time:May 1 18:15-19:30

A preliminary estimation of water content of the mantle beneath Changbaishan Volcano, northeast China

KURITANI, Takeshi[1*] ; OKUMURA, Satoshi[2] ; YOKOYAMA, Tetsuya[3] ; ITO, Yoshinori[2] ; NAKAMURA, Michihiko[2] ; WEI, Haiquan[4]

[1]Osaka City University, [2]Tohoku University, [3]Tokyo Institute of Technology, [4]China Earthquake Administration

In northeast China, Cenozoic intraplate volcanic products are widely distributed. Geophysical studies have suggested that the underlying mantle transition zone is remarkably hydrous (Kelbert et al., 2009) and contains remnants of the subducted Pacific slab (Fukao et al., 1992); therefore, the Pacific slab stagnation and its relation to observed magmatism has received growing attention (e.g., Ohtani and Zhao, 2009; Richard and Iwamori, 2010). Beneath the Changbaishan volcanic field, a prominent low-velocity anomaly with a plume-like shape has been imaged in the upper mantle by P-wave tomography, which is suggestive of an upwelling of a mantle plume from the mantle transition zone (e.g., Zhao et al., 2009). In this study, to characterize the nature of the transition zone-derived mantle plume, the water content of the source mantle is estimated for basaltic products from the Changbaishan volcano.

Basaltic scoria samples were collected from a cinder cone, located about 20 km to the northeast of Tianchi volcano. One scoria sample was used for preliminary analysis of glass inclusions in some plagioclase phenocrysts. Basaltic lavas, which occur with abundant mantle xenoliths, were also collected from the outcrop near the cinder cone to know the primitive magma composition at the volcano. The MgO contents of the scoria and the lava are 5.1 wt.% and 9.1 wt.%, respectively. Major element compositions of quenched glass inclusions in the scoria sample were analyzed using EPMA, and the water contents were estimated by the difference of the analytical total of the major element analysis from 100 wt.%. Through calibration using an in-house standard glass sample of known water content, the water contents of the glass inclusions were obtained to be 0.15-3.4 wt.%. The FT-IR analysis was also performed for one glass inclusion of the estimated water content of 0.15 wt.% by EPMA, which yields the total water content of 0.2 wt.%.

Given that 3.4 wt.% represents the original water content of the melt without leakage, the H_2O/K_2O ratio of the melt of 0.90 is obtained. If we assume that the H_2O/K_2O ratio of the melt was not affected significantly by magmatic processes and the ratio is essentially constant in basaltic magmas at Changbaishan volcano, the water content of the primitive magma (2.4 wt.% in K_2O) is estimated to be 2.2 wt.%. The source mantle for the Changbaishan basalts may contain ˜0.5% sediment component (Kuritani et al., 2011), and the Ce content of the source mantle is estimated to be ˜1.1 ppm using the Ce content of the sediment component of 57.3 ppm (Plank and Langmuir, 1998) and that of the depleted mantle of 0.77 ppm (Salters and Stracke, 2004). If we assume that Ce and H_2O behave similarly during mantle melting (e.g., Michael, 1995), the compositions of the primitive basalt lava (Ce: 70 ppm, H_2O: 2.2 wt.%) yield the water content of the source mantle of ˜350 ppm. This estimated water content is significantly higher than that of the normal depleted mantle (˜120 ppm; Salters and Stracke, 2004), suggesting that the transition zone-derived mantle plume is hydrous compared with the surrounding ambient upper mantle.

In this preliminary study, we have analyzed only seven glass inclusions in a single sample, and therefore, the water content of ˜350 ppm may represent the minimum estimate. It is necessary to increase the number of data by EPMA and FT-IR analyses to more reliably estimate the source water content for the Changbaishan basalts.

Keywords: mantle, water content, China

©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P04 Room:Poster Time:May 1 18:15-19:30

Petrological and geochemical variations within an off-axial submarine large lava flow from the Oman Ophiolite

OTSUKA, Ryo[1*] ; KUSANO, Yuki[1] ; KANAYAMA, Kyoko[1] ; UMINO, Susumu[1]

[1]Department of Earth Sciences, Kanazawa University

Large submarine lava with thicknesses >100 m and volumes exceeding a few cubic kilometers are not uncommon volcanic constructs of mid-ocean ridges and around Hawaii Islands, yet details of the physical processes of eruption of these large lava flows are poorly understood. The V3 flow of the Oman ophiolite extruded at 90 Ma far off the paleospreading axis as thick lava flows with a minimum areal extent of >11 km by 1.5 km and the maximum thickness >270 m, yielding a minimum estimated volume >1.2 cubic kilometers. The V3 flow was fed by a thick feeder dike in the SW of the flow field and buried off-axial fault-bounded basins with a thick sedimentary cover in ~40 days. The upper V3 flow field consists of compound lobes that merge upstream into larger and thicker sheet-like lava, which grew endogenously as a vast sheet lobe.

Low-T hydrothermal alteration and weathering slightly modified the bulk compositions as indicated by moderate albitization of plagioclase and partial replacement of titanomagnetite and clinopyroxene by titanite and chlorite, respectively. However, strong positive correlations among incompatible HFSEs and REEs and relatively good correlations with major elements besides LILEs and Pb show that these elements were less mobile and preserve primary characteristics. FeO and TiO2 show moderate increases with a decrease in MgO from 8 to 5 wt%, and then decreases with the decrease in MgO down to 4 wt%. 20-50 times enrichment in Th and depleted HREEs compared to primitive mantle of the V3 flow is similar to differentiated EMORBs.

Whole-rock major and trace element variations through a vertical transect at 8.7 km (T-21) from the feeder dike show fractional crystallization of clinopyroxene and plagioclase, the major phases in the groundmass of the lava, at a pressure of the paleowater depth. The stratigraphic variations show a notable enrichment in MgO and depletion in incompatible elements in the lowermost core, consistent with accumulation of olivine phenocrysts. Enrichment in incompatible elements in the uppermost core of the flow is in accordance with the model that the last solidified, residual melt resided in this horizon.

By contrast, samples collected from the basal crust every 0.5-1 km from the feeder dike, and vertical transects at 6.7 km (T-14) from the dike have whole-rock compositions spread over compositional spaces that could be explained by internal mixing of variably differentiated magmas. Interestingly, incompatible elements like Yb and Ti of the basal crust show increases downflow to ~5 km from the feeder dike and decreases further downflow. Because the basal crust is the quenched lava that came to rest first at that place, samples farther away from the feeder were extruded and emplaced later in the eruptive event. The downflow variations show extrusion of differentiated lava in the middle stage of the eruption and less differentiated lava in early and late stages. Meanwhile, the transect at T-14 is differentiated in the upper and lower crust and less differentiated in the core.

These intraflow variations in the bulk geochemistry indicate supply of less differentiated magma in an early stage of the eruption, which was progressively replaced by mixed magmas of variably differentiated and less differentiated ones toward the end of the eruption. The eruptive sequence of less differentiated to differentiated magmas with increasing FeO suggests extrusion from a density stratified magma chamber with less dense and Mg-rich magma underlain by more dense Fe-rich magma. The internal mixing among variably differentiated magmas with the progress of the eruption and the extrusion of less differentiated magma toward the end of the eruption suggest a renewal of magma toward the end of the eruption caused mixing of newly supplied less differentiated magma with the differentiated magma within the conduit and the lava tubes.

Keywords: Oman Ophiolite, obduction, V3, Large Lava Flow, chemical variation geochemistry

©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P05 Room:Poster Time:May 1 18:15-19:30

Factors governing fragmentation of submarine lava - mechanism of hyaloclastite formation

UMEZAWA, Yumi[1*] ; UMINO, Susumu[1] ; KUSANO, Yuki[1] ; KANAYAMA, Kyoko[1] ; KITAMURA, Keitaro[1]

[1]Department of Earth Sciences, Kanazawa University

Hyaloclastite is water-lain volcanic breccia embedded in a matrix of glassy clasts by fragmentation of brittle lava under thermal stress. Fluidal basalt lava tends to form coherent flows like pillow lava and sheet flows. In contrast, viscous lava such as andesite and dacite is more likely to form hyaloclastite. This preference of hyaloclastite on lava composition indicates that mechanical response of solidified lava under stress is strongly dependent on composition. Fracturing of lava occurs when the rate of stress accumulation exceeds the rate of stress relaxation and ultimately reaches the mechanical strength of the lava. The rate of stress relaxation decreases with the increase in lava viscosity. Therefore, hyaloclastite is more common in viscous silicic lava.

However, the occurrences of pillow lava of dacite and rhyolite are known from the Ogasawara Islands, Unalaska Island, Oman Ophiolite, etc. Pillow lava is commonly associated with hyaloclastite of the same compositions. These examples demonstrate that factors other than lava composition determines fragmentation of lava. Then, the problem arises what are the governing factors that control the mechanical response of lava under stress. We will address these issues through comparative study on glass, quenched melt, of pillow lava and hyaloclastite of variable compositions spanning from basaltic andesite to rhyolite from the Eocene submarine volcanic strata in Chichijima, Ogasawara Islands.

Samples of glass from these sites were analyzed by EPMA for major elements and by SIMS for water contents. Eruption temperatures were estimated by clinopyroxene-liquid geothermometer of Putirka (2008). Crystal number densities of groundmass plagioclase and clinopyroxene were determined on COMPO images and modal abundance of constituent minerals were determined on element distribution maps of EPMA. Bulk viscosity of lava was estimated by the methods of Giordano et al. (2008) and Pinkerton and Stevenson (1992).

Dacite has phenocrysts of clinopyroxene, orthopyroxene, plagioclase and magnetite. Groundmass consists of clinopyroxene and plagioclase microlites and magnetite set in glass. In dacite glass, there is little difference in melt composition, eruption temperature, crystal number density between pillow lava and hyaloclastite. However, lower water content in hyaloclastite glass than in pillow margin glass yields higher bulk viscosity.

Andesite has phenocrysts of clinopyroxene, orthopyroxene, plagioclase and magnetite. Groundmass consists of clinopyroxene and plagioclase microlites and magnetite set in glass. Clinoenstatite xenocrysts enclosed by orthopyroxene rim are occasionally present. Hyaloclastite is higher in crystal number density and mode of groundmass plagioclase than associated pillow lava. Hyaloclastite glass is lower in Al_2O_3 than associated pillow glass, consistent with preferential crystallization of plagioclase. However, the cpx-saturated melt temperatures show little difference between pillow lava and hyaloclastite. Bulk viscosity estimated for the lava to become hyaloclastite is higher than the lava that formed pillows because of the larger crystal number density in hyaloclastite.

The above observations on dacite glass clearly indicate that water played an essential role in formation of hyaloclastite. Degassing either within the conduit or during flowage through lava tubes raised the bulk viscosity of lava and stress relaxation time, resulted in fragmentation of lava to form hyaloclastite. Although water content was not determined for andesite glass, higher crystal number density and modal amount of plagioclase in hyaloclastite with the same temperature as the coexisting pillow lava can be explained by volatile loss which raised the liquidus of plagioclase and its preferential crystallization, resulted in higher bulk viscosity and fragmentation of lava.

Keywords: hyaloclatite, the Bonin Islands Chichijima, viscosity, submarine lava

Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)
©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P06 Room:Poster Time:May 1 18:15-19:30

Eruption history and petrography of Akanfuji in the Me-akan volcano, eastern Hokkaido, Japan

SATO, Eiichi[1*] ; WADA, Keiji[2]

[1]Institute for Promotion of Higher Education, Kobe University, [2]Hokkaido University of Education at Asahikawa

Me-akan volcano is located in the Akan volcanic field, eastern Hokkaido, and ~250 km inland from the Kuril trench. The volcanic activity of Me-akan volcano began at least a few tens thousand years ago, and eight volcanic bodies with different peaks have been formed.

Akanfuji (1476 m), which is the newest volcanic body in the Me-akan volcano, started its eruptions about 2.5 ka, and the volcanic activity continued for 1,500 years. The eruption products of Akanfuji are composed of scoria fall deposits and lava flows. The scoria fall deposits are distributed from northeast to south from present vent. We described the scoria fall deposits to interpret the complex depositional sequence. As a result, 17 scoria fall layers were recognized for 1,500 years.

Akanfuji had erupted basalts through its history. Two types of basalts (types I and II) are recognized on the basis of phenocrysts assemblage. Type I is orthopyroxene (opx) bearing olivine (ol)-crynopyroxene (cpx) basalt and Type II is cpx bearing ol-opx basalt. They were formed by mixing between different types of basaltic magmas on the basis of the textural and mineralogical evidences.

Keywords: Me-akan volcano, Akanfuji, Eruption history, basalt, magma mixing

Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)
©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P07 Room:Poster Time:May 1 18:15-19:30

Evidence of eruption episodes before AD1741 of Oshima-Oshima Volcano, Hokkaido, Japan

YOSHIMOTO, Mitsuhiro[1*] ; NAKAMURA, Yugo[1] ; FUKUHARA, Genta[2] ; NISHIMURA, Yuichi[1]

[1]Faculty of Science, Hokkaido University, [2]Faculty of Science, Hokkaido University

We newly identified two eruption episodes of Oshima-oshima volcano below eruption products of the AD 1741 eruption at an outcrop on the summit of the volcano. The upper eruption product consists of alternating volcanic lapilli fall and ash fall deposits, and the lower one consists of scoria fall deposits. Tephra from those eruptions have not found in the other area including southern Hokkaido. We also identified two thin tephra layers between three eruption products of Oshima-oshima volcano with intercalating soil layers. They are correlating with well-known wide spread tephras such as Ko-d (AD 1640) from Hokkaido-Komagatake Volcano and B-Tm (ca. AD 940) from Changbaishan Volcano, China-North Korea, based on chemistry of volcanic glass shards. Considering the thickness of soil layers, those eruption episodes would occur at around AD 1450 and BC 600. It suggests that Oshima-Oshima volcano erupted at least 4 times in last 2500 years including 2 historical eruptions in AD 1741-1742 and 1759.
This work was supported by JSPS Grant-in-Aid for Scientific Research C, Grant Number 24540447.

Keywords: Oshima-oshima, eruption history, tephra

©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P08 Room:Poster Time:May 1 18:15-19:30

Compositional variation and magmatic differentiation at the northern Kita-Hakkoda volcanic group

KOMATSU, Sho[1*] ; OHBA, Tsukasa[1]

[1]Akita Univ.

Since 0.6 Ma, magmatic eruptions have occurred several times at Kita-Hakkoda volcanic group. This study focuses on the activity between 0.4 and 0.2 Ma. Magmatic differentiation process is investigated from whole-rock chemistry and mineralogy along with stratigraphy. This area consists of 12 geologic layers: Hakkoda 2nd Stage Pyroclastic Flow Deposit, Northern Kita-Hakkoda Basaltic Andesite Lavas, Lower Kansuisawa Pumice Flow Deposit, Lower Tamoyachi-dake Andesite Lavas, Upper Kansuisawa Pumice Flow deposit, the Upper Tamoyachi-dake Andesite Lavas, the Tashirotai Lacutrine Deposit, Narusawa Debris Flow Deposit, Maedake Lavas, Narusawa-daichi Andesite Lavas, Okuzuresawa Debris Flow Deposit and Okuzuresawa Pyroclasitic Flow deposit in stratigraphic order. Temporal variation of chemical composition in stratigraphic order is evaluated. The activity initiated with the effusion of differentiated tholeiitic basaltic magma around 0.4 Ma. After a dormancy the activity resumed around 0.2 Ma with effusion of andesitic magma (60wt% SiO_2), followed by a fluctuating activity between tholeiitic basalt and low-silica calc-alkaline andesite magmas. Then, the magma composition jumped to high silica (60wt% SiO_2) calc-alkaline andesite. No evidence for open system process is recorded in phenocrysts in the tholeiitic rocks. Previous studies accounted for the chemical variation of tholeiitic magma by crystallization differentiation, and our new data is consistent with the model. Disequilibrium mineral assemblages in calc-alkaline rocks, e.g., coexistences of magnesian olivine and embayed quartz, and of reversely zoned pyroxenes and normally zoned pyroxenes, implies open system processes. As indicated by linear trends between tholeiitic basalt and the high-silica andesite, magma mixing is a plausible process to produce the series. Stratigraphic chemical variation might be caused by temporal variation in mixing ratios.

Keywords: Magma mixing

©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P09 Room:Poster Time:May 1 18:15-19:30

The volcanic history and geological structure of Sanzugawa Caldera, Yuzawa, Akita prefecture

OKI, Fumiya[1*] ; OHBA, Tsukasa[1]

[1]Akita Univ.

Sanzugawa caldera, located in the southern part of Akita prefecture, was formed by collapses after eruptions of voluminous ash flows about >ca. 1 Ma. Torageyama Formation, deposited during the caldera formation, thickly infills the caldera depression. The Formation is divided into two members: Torageyama tuff member and Minasegawa tuff member. Torageyama tuff member consists of welded tuff, lapilli tuff, and alternation of tuffaceous sandstone, mudstone, and conglomerate. Thickness of Torageyama tuff member is approximatly 900m. Minasegawa tuff member consists of lapilli tuff, tuff and conglomerate. Thickness of Minasegawa tuff member is about 450m. In this study, on the basis of lithology, Torageyama Formation is divided into 10 layers, including pyroclastic density current deposits (PDC-1 to PDC-8), a debris flow deposit (DF-1) and a lacustrine deposit (LD-1). Stratigraphic order from the bottom is PDC-1, DF-1, LD-1 and PDC-2 to PDC-8. Approximate thicknesses of the layers are 20m, 80m, 140m, 50m, 250m, 200m, 340m, 160m, 90m and 30m, respectively. Pyroclastic density current deposits consist of massive lapilli tuff. The lapilli tuff contains pumice clasts and lithics, and minor amount of wood pieces. Bases of PDC-4 and PDC-6 consist of ground surge deposits. Low-angle cross-laminar and dunes are developed in the ground surge deposits. The ground surge deposit of PDC-6 is further underlied by a ground breccia layer. The ground breccia layer consists of matrix-supported conglomerate, containing lithics with a maximum grain-size of 2.5 m. Lapilli tuff of PDC-1, 3, 4, 8 include welded parts, developing degassing pipes and columnar joints. Welded parts often contain spherulites and exhibit eutaxitic texture. Debris flow deposit (DF-1) consists of clast-supported conglomerate with rounded clasts. The clasts are directed parallel to the bedding plane, showing coarse-tail reverse grading. Lacustrine deposit (LD-1) consists of alternation of tuffaceous sandstone, mudstone, and conglomerate. In mudstone, laminar is well developed. Laminar and bedding are well developed in tuffaceous sandstone. Conglomerate is massive. PDC-2 overlying the lacustrine deposit (LD-1) shows sedimentary structures that imply subaqueous setting. Pyroclastic density current occurred more than eight times, suggested by the number of pyroclastic density current layers. The source of PDC-4 is Takinohara vent, determined from paleocurrent estimated with dunes of a ground surge deposit. Presence of a lacustrine deposit (LD-1) in the middle of the Formation implies that caldera collapsed two times. Half-concentric distribution of strike surrounds Mt. Ishigami and their dips incline outward of the caldera. This structure implies a resurgent dome. This resurgent dome resulted in uplift of Oyasudake area where the center of the caldera. Presence of resurgent dome, thick pyroclastic density current deposits and ring fractures suggests that Sanzugawa caldera is classified as a Valles type caldera.

Keywords: Sanzugawa caldera, Torageyama Formation, Pyroclastic density current deposit, Resurgent dome

Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)
©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P10 Room:Poster Time:May 1 18:15-19:30

Stratigraphy and chemical compositions of eruption products in Umanose agglutinate activity, Zao volcano

KAWANO, Gen[1*] ; BAN, Masao[2] ; OIKAWA, Teruki[3]

[1]Graduate School of Science and Engineering, Yamagata University, [2]Faculty of Science, Yamagata University, [3]Geological Survey of Japan/ AIST

The newest stage of the Zao volcano, central part of NE Japan, began at about 30 ka and the activity has continued to present. The Zao newest stage eruption products are classified into Komakusadaira agglutinate, Umanose agglutinate and Goshikidake pyroclastics. In this study, we examined the stratigraphy of eruption products in the Umanose agglutinate activity (ca. 8-4 ka). Besides, we examined temporal change in chemical compositions of the products.

≪Tephra-stratigraphy≫ We re-examined the tephra-stratigraphy and recognized nine volcanic sand layers (Z-To 5a, 5b, 5c, 5d, 5e, 5, 6, 7, 8) during the Umanose agglutinate activity. The tephra (volcanic sand) layers younger than the Z-To 5e widely distribute around the summit area, while the others are found only in the northern part. Based on ^{14}C ages on paleosols and fossil leaf samples from the tephra-loam succession coupled with the stratigraphy, ages of Z-To 5a to 8, except for Z-To 5, are estimated to be ca. 8.9, 7.3, 6.0, 5.6, 5.3, 4.7, 3.9, 3.6 ka, respectively.

In addition, we found whitish yellow colored wide-spread tephra layer between Z-To 5e and 5d in the northern and bellow 5e in the southern part of the summit area. This tephra is mainly composed of pumice type volcanic glass. This layer can be correlated to To-Cu (Towada-Chuseri) tephra, based on the major element compositions of the volcanic glass and the stratigraphic horizon.

≪Stratigraphy of the proximal layers≫ The proximal layers are well exposed in the central part of the summit area. In this part, the Umanose agglutinate covers the Komakusadaira agglutinate, which include less-vesiculated volcanic bombs with glassy luster as well as scoria. Overlying products of the Umanose agglutinate are composed of alternation of agglutinate, scoria fall deposit, and pyroclastic surge deposit. More than ten layers are recognized by intercalating loam layers.

≪Temporal change in chemical compositions≫ The eruptive products are olivine +- pyroxene andesite (56.0-59.2% SiO_2) and belong to medium-K calc-alkaline series. All samples are plotted on same linear trends in SiO_2 variation diagrams. The silica contents increase gradually from the bottom to the middle part. Afterwards, the content drops to the lowest, and gradually increase upwards again.

Keywords: Zao volcano, Umanose agglutinate, tephra stratigraphy, evolution of magma

Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)
©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P11 Room:Poster Time:May 1 18:15-19:30

Eruptive History of Post-caldera Stage, East-Azuma Volcano -Correlation between ejecta intra-caldera and boring core-

OZAKI, Mamoru[1*] ; FUJINAWA, Akihiko[2]

[1]Ibaraki Univ., [2]Ibaraki Univ.

Introduction

Azuma Volcano is one of the Quaternary stratovolcanoes located at the volcanic front of the Northeast Japan arc. The recent 7ka activities of this volcano are characterized by dominant fall out tephra (Yamamoto, 2005). Eruptive history occurred at the Jododaira explosion caldera (Fujinawa and Kamoshida, 1999) is built by comparing boring core of the Jododaira with the ejecta deposited the intra-caldera area.

Stratigraphy and lithofacies of boring core

Boring site is at about 500m NW from Azuma-Kofuji cone. This core was described most immediately after core-recovery, and stratigraphic sequence was outlined (CCPVE core analysis group, 2011). Layers of andesitic volcanic block and lapilli (11.20m-1.50m in depth) are lithologically correlated to the Azuma-Kofuji volcanic ejecta.

Andesite lava (100.55m-81.07m, sample No.19-17 near the bottom of the core) and welded tuff breccia / lapilli tuff (79.90m-14.20m, No.13-10) are to be the keys to reveal the eruption history. Andesite lava (19-17) is dark-gray in color with dominant plagioclase phenocrysts of 2˜3mm in diameter. Inclusions are rarely recognizable. Welded tuff breccia/lapilli tuff (No. 13-10) are characterized by dark-gray, highly deformed and elongated blocks/lapilli at the densely welded part.

Description of outcrops

3 lava flows and 1 pyroclastic flow deposit were newly found at the outcrops of intra-caldera area.

Lava flow1 (Lf1) does not show distinct lobe topography. This is exposed only at altitudes of 430m along forest road with about 5m thick. Lf1 is massive, dark-gray in color and characterized by dominant plagioclase phenocrysts of 2˜3mm in diameter. Rare cognate inclusion is also recognized.

Pyroclastic flow deposit (Pfl) intermittently cropped out around at altitudes of 470m along the route 126, showing a thickness about 2.5m. The Pfl is overlain by unconsolidated talus deposit. The stratigraphy of these deposits was not confirmed in the field observation. This Pfl includes dark-gray lithic fragments in weakly welded light-gray matrix.

Lava flow2 (Lf2) constitutes thick massive spreading widely on the floor of the Jododaira explosion caldera (Fujinawa and Kamoshida, 1999). Judged from topography, the Lf2 storatigraphically overlies the Pfl. At altitudes of 660m along forest road, the Lf2 of over 10m in thick showing an well-developed columnar joint is cropped out. The Lf2 is directly covered by Ak-Lf at this locality (Kamoshida, 1991MS). Lithology of Lf2 is massive, gray in color and pyroxene phenocrysts are secerned easily.

Lava flow3 (Lf3) is distributed in the southern part of the intra-caldera, well foamed and grey tinged with red in color. The Lf3 topographically overlies the Lf2, furthermore, and covered by Ak-Lf. The Lf3 consists of 3˜5 flow units, lobes and levees at its surface.

Comparison of lithofacies

The lava samples of the core (19˜17) are lithographically similar to those for the Lf1, but distinguishable to those of the Lf2 or Lf3. The core samples of the welded tuff (13˜10) is slightly different from Pfl in the degree of welding, but are similar to each other in terms of including dark-gray lithic fragments in light-gray matrix.

Eruptive history based on comparison of lithofacies

The welded pyroclastic deposits in boring core are as thick as 20m, suggesting that the deposit is the deposit of an enormous pyroclastic eruption. If such eruption occurs, a sort of depression would often be remained in the supply source area. Judging from topography, the Jododaira explosion caldera is the most plausible candidate. Because the Lf1 (=core 19˜17) lie beneath welded Pfl (=core 13˜10), this lava is promisingly erupted during pre-caldera activities. Because the Lf2 and Lf3 are topographically come above the Lf1, it is considered that these lavas erupted in the post-caldera stage.

Keywords: Azuma Volcano, Jododaira, eruptive history, boring core, stratigraphy

©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P12 Room:Poster Time:May 1 18:15-19:30

Plagioclase phenocrysts and Opx-magnetite symplectite of the Sessho Lava of the Kusatsu-Shirane Volcano

OSHIO, Kazuki[1*] ; UEKI, Kenta[2] ; KAWANO, Munehiro[3] ; INUI, Mutsuko[3] ; NOGAMI, Kenji[2]

[1]Kokushikan University Graduate School of Engineering, [2]Volcanic Fluid Research Center, Tokyo Institute of Technology, [3]Kokushikan University

Chemical composition and crystal size distribution of plagioclase phenocrysts may represent the cooling rate and chemical heterogeneity of the magma chamber. Therefore, chemical and physical conditions in the magma storage before eruption can be constrained by analyzing the morphology and chemical composition of phenocrysts in lava.

For the purpose, we focused on the Sessho lava, a single lava flow erupted from Kusatsu-Shirane volcano. Kusatsu-Shirane volcano is a quaternary active volcano located in the Central Japan arc. According to Uto *et al.* (1983), the Sessho lava is estimated to have erupted from the Moto Shirane cone during an eruption about 3000 years ago. The Sessho lava shows andesitic composition (Takahashi *et al.*, 2010; Ueki and Terada, 2012). In this study, detailed descriptions in morphologies of phenocryst minerals have been carried out. We determined the modal composition of phenocrysts, and measured the aspect ratio and the crystal size distribution of plagioclase phenocryst. We also carried out the detailed description of opx-magnetite symplectite, which have been observed in several samples.

The phenocrysts assemblage of the Sessho lava is plagioclase, clinopyroxene, orthopyroxene, magnetite, and rare olivine. Groundmass shows glassy structure. Modal composition of phenocrysts shows homogeneous value in a single lava flow; 54.0 to 59.0 vol. % for groundmass, 33.4 to 38.1 vol. % for plagioclase, 2.1 to for 4.2 vol. % for magnetite, 3.0 to 6.4 vol. % for pyroxene. On the other hand, the aspect ratios of plagioclase phenocrysts show wide range of variation in a single lava flow. Fine grained plagioclase shows needle-like morphology whereas coarse grained plagioclase shows tabular morphology. Although the modal composition shows the homogeneous value, sizes of plagioclase phenocrysts show wide range of variation; samples rich in fine-grained phenocrysts and samples rich in coarse-grained phenocrysts are both present in the single lava flow.

Observations and quantitative analysis using EPMA and SEM show that the structure of plagioclase phenocrysts can be classified into following five groups; normal zoning, reverse zoning, oscillatory zoning, patchy zoning, dusty zoning. Plagioclase phenocrysts show a wide range of composition in the single lava flow. An# ranges 55-84 %. Olivine phenocryst is observed in some samples, its Mg# is -83, which is a non-equilibrium composition with its host rock.

Opx-magnetite symplectite have been observed in several samples. The symplectite show oval form. Its diameter ranges 2-4 mm. Magnetite shows lamella structure, and is concentrated at the central part of the symplectite. Orthopyroxene is 75-975 μm in diameter and distributes around the magnetite lamella. Orthopyroxene in the symplectite is characterized by its low birefringence than the typical orthopyroxene phenocrysts of the Sessho lava. This structure is estimated to be formed by the rapid oxidation of olivine, indicating that during the formation of andesite magma of Sessho lava, oxygen fugacity in the magma storage may have rapidly increased.

In conclusion, it is estimated that final temperature was homogeneous in the magma strage of the Sessho lava, because modal contents of phenocrysts in the single lava flow show homogeneous value. On the other hand, several types of the chemical composition and size of plagioclase have been observed in the lava flow, indicating rate of crystallization and cooling had variation in the magma storage of the Sessho lava. Existences of orthopyroxene-magnetite symplectite and non-equilibrium olivine indicate magma mixing and oxidization event had occurred during the formation of andesitic magma of the Kusatsu-Shirane volcano.

References

Uto *et al.*, Kusatsu-Shirane volcano geological map, Geological Survey (1983)

Takahashi *et al.*, Nihon University College of Humanities and Sciences, Research bulletins, 45, 205-254 (2010)

Ueki & Terada, Volcano 57, 4, 235-251 (2012)

Keywords: Lava flow, Crystal size distribution, Eruption, Andesite, Active volcano, Symplectite

Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)
©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P13 Room:Poster Time:May 1 18:15-19:30

Boring Core Observation of the Izu Oshima Sembazaki Strain Meter Well.

KAWANABE, Yoshihisa[1*] ; ONIZAWA, Shin'ya[2] ; KOKUBO, Kazuya[3]

[1]Geol. Surv. Japan, AIST, [2]Meteorological Research Institute, [3]Japan Meteorological Agency

We report the boring core observations of strain gauge well that Japan Meteorological Agency has been installed in the Sembasaki, Izu Oshima. The location of the well is at 34 42' 20.5168 "N, and 139 21' 40.7016"E, and well altitude is 51.2m, and drilling depth is 100m. For deeper than about 70m deep, the core was recovered.

Depth from 70m to 86m is composed of volcanic breccia with thin layers of volcanic ash. Volcanic breccia is solidified and including fragments of various basalt, scoria and altered rocks. Some basalt fragments seems to be the essential with a quench rim. From the surrounding geology, this breccia can be compared to the Senzu Formation that is the product of explosive eruption at shallow sea in the first stage of Izu Oshima volcano.

The core, depth of 86m (below sea level 34.8m) or deeper, is made of fresh aphyric basaltic lava flow. At least 2 flow units can be identified. Both lava flows contain very small amount of plagioclase and clinopyroxene phenocrysts. There is no evidence that is water-cooled to the lava flow.

We performed the whole rock chemical composition analysis for basalt fragment of breccia and lava flows. All specimen have SiO_2 = 49.8 ~52.9wt% and significantly lower K_2O content, about 0.2wt%, than the basalts of Izu Oshima volcano, except for one breccia fragment. The lower K_2O content than that of the rock of Izu Oshima volcano is consistent with the characteristics of the old basement volcanoes such as Fudeshima volcano.

In the sea floor of the west of the Izu Oshima, there are Semba spur accompanied by magnetic anomaly. Oshima et.al.(1987) pointed out that the Semba spur might be the older volcanic body and they named it Semba volcano. The height of the sea cliff is gradually increased from Sembazaki toward the north, and the highest around Tsuwai. The distribution of valleys around Tsuwai also shows the discordant rise in the foot of Izu Oshima volcano, and this discordant may lead to the Semba spur. The basalts from the Semba core indicate that the old basement volcano, Semba volcano, is also present in the Izu-Oshima southwest side.

Keywords: Izu Oshima, boring core, basalt

©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P14 Room:Poster Time:May 1 18:15-19:30

Origin and deformation of the clastic flow bands in the Takanoobane rhyolite lava

FURUKAWA, Kuniyuki[1*] ; KANAMARU, Tatsuo[2] ; UNO, Koji[3]

[1]Faculty of Business Administration, Aichi University, [2]Department of Geosystem Sciences, College of Humanities and Sciences, Nihon University, [3]Graduate School of Education, Okayama University

In this study, we showed that the clastic flow bands, which are developed in the Takanoobane rhyolite lava, were formed by shear fracturing of the high viscous magma within the shallow conduit. The flow bands broke up into the small particle-rich flow lines, which are ubiquitously observed in obsidian lavas.

The Takanoobane rhyolite lava (TR lava) is located at the Aso caldera in the middle of Kyushu Island in SW Japan. The lava is effused at 51+/-5 ka (Matsumoto et al., 1991). The thickness, estimated volume, and bulk rock chemistry of TR lava are 60-90 m, 0.14 km^3 (Miyabuchi et al., 2004), and 71-72 SiO_2 wt.% (Furukawa, 2006), respectively. In this study, we examined two drill cores (AVL1 and AVL4) provided by the Aso Volcanological Laboratory. Both drill holes penetrated the proximal part of TR lava. TR lava is composed of an inner crystalline part and marginal glassy parts.

The black to dark gray colored flow bands within a few millimeters thick are concentrated around the boundary between crystalline part and basal obsidian. The bands are composed of clastic materials with a diameter below a few mm. The clastic materials are composed of glassy lithics and minerals. Some clasts are rounded and fluidal shapes and show different textural occurrences from the surrounding rhyolite. The chemical compositions of the glassy lithics and those of glassy matrix of the surrounding rhyolite are slightly different. Within the bands, the streak texture, which is defined by difference of clasts and microlite contents, is conspicuous.

The differences in texture and chemical compositions between the clasts in the bands and surrounding rhyolite indicate that the clastic bands were not formed by autobrecciation within the lava. These observations indicate that the clastic bands are likely to be formed by shear fracturing of the high viscous magma within the shallow conduit such as Tuffen et al. (2003). The fractures would become pathway of the volcanic gasses, and the clasts were transported by the gas transport. The streak texture within the bands is interpreted as sedimentary structures, which were formed by gas transportation of clasts through fracture system. The rounded and fluidal shapes of the clasts indicate that the fracturing occurred when the conduit magma was enough hot. The clastic bands consequently break up and disappear. The bands show progressive loosening along the individual streak, where will be the structural weakness. Consequently, the streak develops into the individual thin bands. The small particles, such as glass particles, microlites and lithics, are released from margin of the clastic bands to the surrounding rhyolite. Since the high viscosity of the lava inhibits their homogenization, the particles are likely to be aligned along the flow line. The clastic flow bands, originated from shear fracturing, will thoroughly break up via this process. Our results mean that the clastic flow bands developed within silicic lavas is important for understanding of the shallow conduit system of silicic magma.

Keywords: rhyolite, lava, flow band, conduit, Aso

Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)
©2014. Japan Geoscience Union. All Rights Reserved.

SVC54-P15 Room:Poster Time:May 1 18:15-19:30

Magma chamber processes revealed by textures in plagioclase phenocrysts through Taisho eruptions of Sakurajima volcano

YAMASHITA, Shunsuke[1*] ; TORAMARU, Atsushi[2]

[1]Department of Earth and Planetary Sciences, Graduate School of Sciences, [2]Department of Earth and Planetary Sciences, Faculty of Sciences

Textures in volcanic products record important information about the origin of the rock. Especially, plagioclase phenocrysts have been studied in order to understand the magma chamber processes because they are commonly included in various types of volcanic rocks. Two types of plagioclase phenocrysts are found in lavas by the 1914-1915 eruption of Sakurajima volcano, Southern Kyushu, Japan: (1) honeycomb plagioclase(H-Pl) with large melt inclusions in cores; and(2) clear plagioclase(C-Pl) without any melt inclusions. In Sakurajima volcano, magma mixing has been suggested by bimodal compositions of plagioclase phenocrysts. However, relationship between textures and chemical compositions has not been reported. In addition, the crystal size distributions (CSDs) also may provide essential information for the production environment of the crystals. Therefore, in order to obtain insights into magma chamber and magma mixing processes, we conduct chemical composition and crystal size distribution (CSD) analyses.

We carried out chemical compositional analysis by FE-SEM. As a result, it is found that H-Pl phenocrysts have heterogeneous mozaic cores with An75-90 and An55-70 and very low An#(An40-55) around melt inclusions. On the other hand, C-Pl phenocrysts are uniform in compositions while the An contents varies from grain to grain. The histogram of An contents in H-Pl cores shows narrow bimodal distributions around An78 and An86, whereas that of C-Pl cores shows the wide bimodal distribution around An62 and An86. We carried out CSD analysis. It is found that H-Pl and C-Pl phenocrysts showed different trends. CSD of C-Pl is strongly convex-downward showing crossover with two different slopes.

We revealed plagioclase are classified into three types: (1) type-H with an An-rich (An74-89) and heterogeneous core containing large melt inclusions; and (2) type-C-1 with an An62 and homogeneous core not containing melt inclusions; and (3) type-C-2 with an An-rich (An85) and homogeneous core not containing melt inclusions. The results of CSD suggest different formation pocesses between H-Pl and C-Pl, and crossover in the slopes of C-Pl CSDs suggest the mixing of two magmas from which two populations of phenocrysts originate (Higgins, 1996b). In Sakurajima, magma mixing has been suggested, therefore it is important to understand the temperature of magmas. So, we estimated temperature on equilibrium constants by plagioclase- and alkali feldspar-liquid thermobarometers (Putirka, 2008). The results show the temperature on equilibrium constants of the dacitic magma was about 850 ℃, and that of the basaltic magma was about 1050 ℃. Since the honeycomb plagioclases are generated by the skeletal growth under high supercooling condition, the H-Pl phenocrysts is formed in the basaltic magmas during cooling at mixing events. In summary, type-H is formed by skeletal growth due to the thermal interaction during mixing events in basaltic magma, type-C-1 is formed under magma chamber with mixed homogeneous magma, type-C-2 is formed under magma chamber with the basaltic magma before mixing, respectively.

Keywords: plagioclase phenocryst, honeycomb texture, textural analysis, crystal size distribution, magma mixing, Sakurajima volcano