The mayor who confront the crisis of the volcano that did not erupt; Sakurajima 2015

*Kazuyuki Nakagawa[1]

1. Commentator ,Jiji Press

The mayor who confront the crisis of the volcano that did not erupt; Sakurajima 2015

Keywords: Sakurajima, Inclinometer, Mayor of Kagoshima

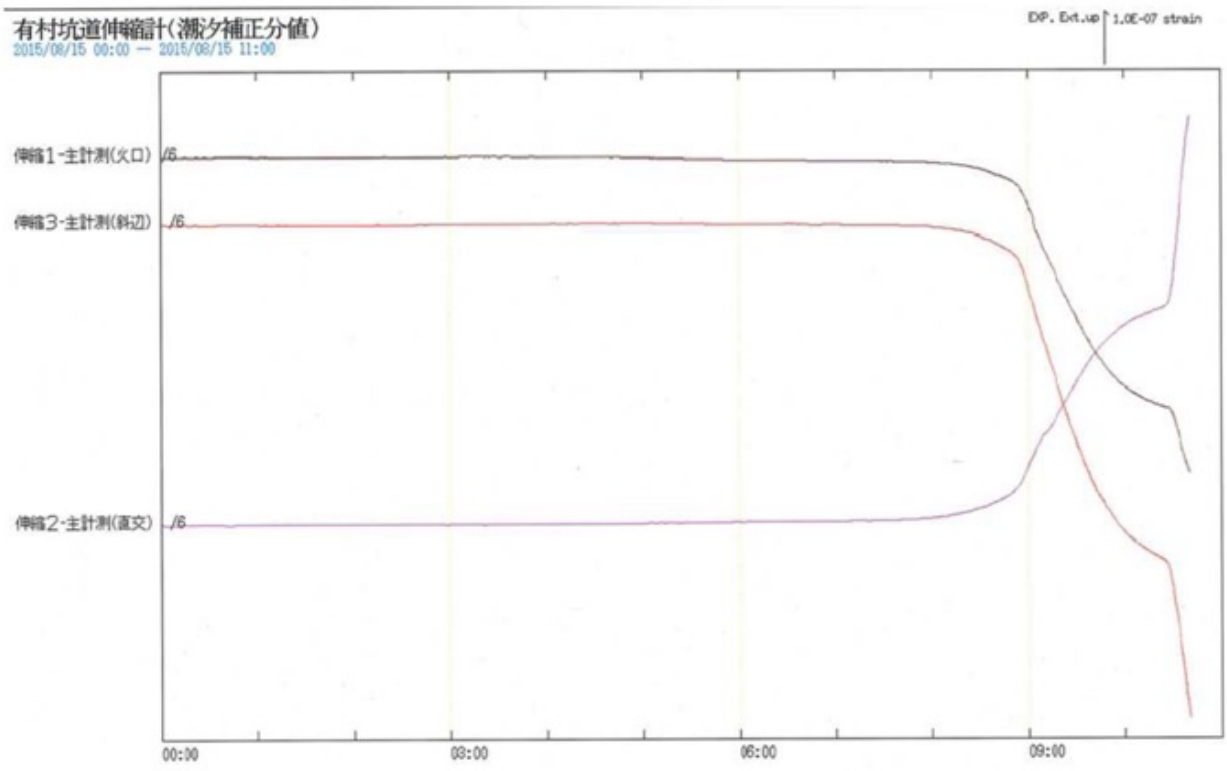


図1　桜島　有村坑道の伸縮計の変化（2015 年 8 月 15 日 0 時～11 時）

Development of mobile sensor for volcanic observation “HOMURA”: operation at Kirishima Iwo-yama and test for a long-term operation at Kyoto University

*Katsuya Kaneko[1], Kodai Iwahori[2], Koichi Ito[2], Hirotaro Sagi[3]

1. Graduate School of Science, Kobe University, 2. Graduate School of Science, Kyoto University, 3. Integrated Human Studies, Kyoto University

Monitoring of phenomena near craters of active volcanoes is important to learn symptoms of volcanic eruptions and to understand eruption dynamics. At present, some devices such as crater camera, volcanic gas sensors, and seismographs have been installed in calm periods of volcanic activity. On the other hand, there are some cases where we cannot install new monitoring devices at volcanoes without enough devices after volcanic eruptions occur. In this case, unmanned robots are useful. We are trying to develop a practical unmanned-ground-vehicle-type robot for volcanic observation that carries out monitoring near active craters. We named this system "Homura". In this presentation, we report results of test campaigns for operation of Homura in outdoor fields.

At present, we have developed a prototype of Homura. It is a small-sized, vehicle-type robot with six wheels (750 x 430 x 310 mm in dimensions and a weight of about 12 kg). It is remotely controlled with mobile phone radio waves; it can move in volcanic fields and send real time data of sensors (camera, thermometer, and CO2 gas sensor for test) equipped in the vehicle to the base station. Power consumption of Homura is about 20 W in an operation state and less than 0.1 W in an idle state, so that we can use Homura for a long time by intermittent operation.

We carried out two test campaigns of Homura at Kirishima Iwo-yama from Feb. 19th, to May 5th (49 days) and from Mar. 3rd to Apr. 14th (37 days). Iwo-yama is one of craters in the Kirishima volcanic field, SW Japan; after 2014 volcanic seismicity sometimes increases around Iwo-yama and there is danger of eruptions. We carried and put Homura at the rim of the crater. Unfortunately, mobile phone connectivity was not entirely stable around Iwo-yama. Then, we decided not to move Homura and only to obtain real time data of the sensors. After we returned to our office, we operated Homura for one to two hours every day. Although the weather was often bad (rain, fog, or cold temperature) during the test campaigns, we could completely operate Homura without any trouble. In order to use Homura for longer period, we installed a small solar panel on Homura. Since Oct. 10th, we have been operating Homura at the roof of a building in Kyoto University. Homura obtain sensor data for 4 minutes every 6 hours. Up to the present (128 days), we can stably operate Homura.

The results of these test campaigns indicate that Homura steadily functions for a long time in volcanic fields. Homura is useful as a simple monitoring station in volcanic fields where mobile phone connection is available.

This work was supported partly by a grant-in-aid for scientific research from the Japan Society for the Promotion of Science and the Earthquake Research Institute cooperative research program.

Keywords: Robot for monitoring volcanoes, Kirishima Iwo-yama, communication with cellular phone

Facies and thickness variations and emplacement mechanism of Aso-4 pyroclastic flow

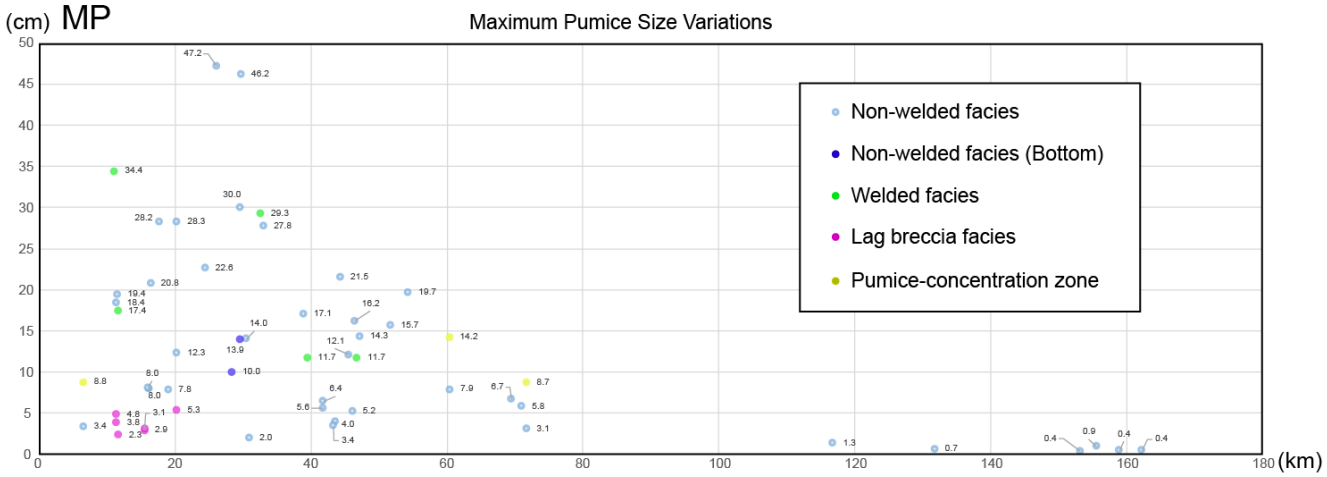
*Shinji Takarada[1], Hideo Hoshizumi[1]

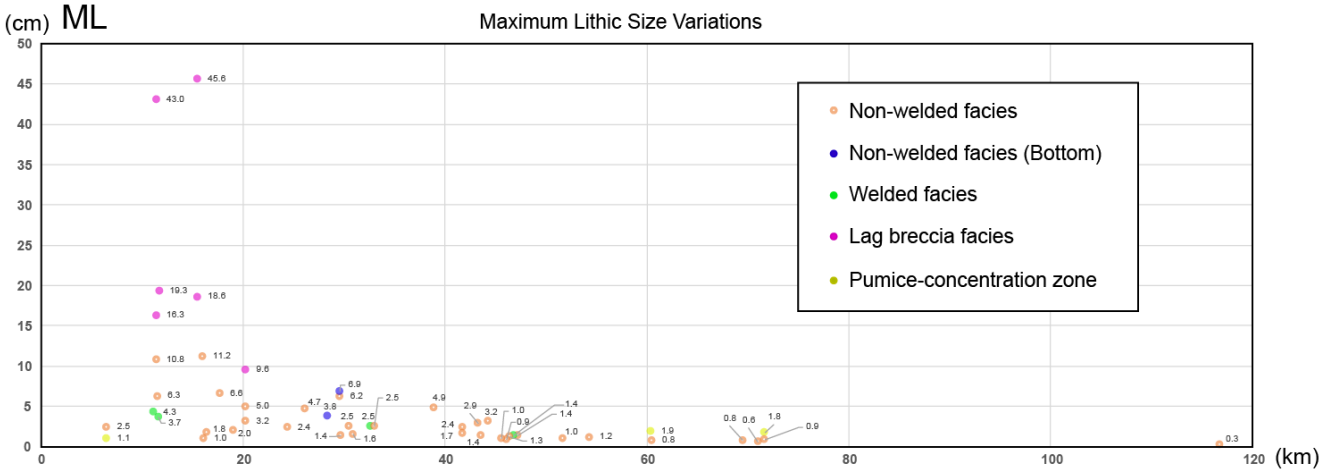
1. Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology

Pyroclastic flows, normally high-temperature and high-speed, cause devastations in and around the volcanic area. Especially, caldera-forming, large-scale pyroclastic flows (ignimbrites) affect quite large areas, and more precise evaluation of affected area and understanding of emplacement mechanism are needed. The 90ka Aso4 pyroclastic flow is one of the largest volcanic events in Japan (VEI=7), and reached as far as 160km from the source. We studied emplacement mechanism of Aso4 pyroclastic flows based on facies and thickness variations.
The total number of 3,596 thickness point datasets was collected using geological maps, boring data, published papers and topographic maps. The thickness of the welded points was converted to non-welded condition based on average densities of welded part (1,800 kg/m^3) and non-welded part (1,200kg/m^3). The thickness variation map was made based on point datasets using Kriging method. The maximum thickness locations that is thicker than 60m were distributed not near the caldera, but NNW 42.5km from source (NW of Oguni town), SSW 33km (N of Kunimi dake) and SE 29km (Takachiho valley). These areas are located relatively deep valley. The reason of the thick deposit in the deep valley can be explained more than a few hundred meters-thick turbulent pyroclastic flows were cascaded the caldera outer slope and most of the deposits in the relatively steep slopes were concentrated in the deep valley. The deposit thickness in the wide valley in eastern and western parts were relatively thin (<40m).
The grain size variations were studied mainly on Aso4A deposit from NW, N, E and SE directions. The maximum pumice and thick sizes were examined at 55 outcrops in total. The maximum size of pumices and lithics of 8 samples in each outcrop were measured (Fig.). The maximum size of pumices (47.2cm and 46.2cm) are located not near the caldera, but about 25-30km from the source. The maximum size gradually decreases up to 3 cm at 72km. The maximum size of pumices at outcrops in Yamaguchi prefecture (132-162km from the source) show 0.4-0.9cm. The maximum size of pumices varies vertically in an outcrop. The pumice sizes in the basal part was relatively smaller than the main part. The pumice sizes in the pumice-concentration zone were relatively larger than the main part. The pumice sizes in the welded and non-welded parts show minor differences. The maximum pumice size in the lag breccia facies located within 20km from the source show small values (2.3 to 5.3 cm). On the other hand, maximum sizes of lithics show maximum of 43 and 45.6cm at 10-15 km from the source. The maximum size of lithics gradually decreased with travel distance and showed 0.3 cm at 117 km from the source. A 8m-thick lag breccia facies are observed at the bottom of 15m-thick Aso4A pyroclastic flow deposit located at 11 km SE from source. The lag breccia facies were subdivided into 3 units and bottom of the basal unit was not observed. The lag breccia facies consist of fines-depleted matrix and subrounded large-amount of large lithics (70cm in maximum) and small amount of pumices. Large lithics in the lag breccia units show stratified structures such as horizontal alignments with 20-50cm thick intervals.
The lag breccia facies are located within 20km from source. The facies are formed due to detachment of large lithics from the highly turbulent pyroclastic flow near the source. The fines-depleted facies support the highly turbulence. The subrounded lithics in the lag breccia facies indicate that the lithics were not fall origin, but rounded due to interaction at the bottom of turbulent pyroclastic flow. The horizontal alignments of large lithics indicate the lag breccia facies were not formed in mass freezing, but formed incrementally at 20-50cm-thick intervals (depositional subunits; DSU). The alignment of large lithics suggest that lithics were concentrated at the bottom of the turbulent pyroclastic flow (boundary layer) and

increased the interaction between the lithics and formed concentrated at the top of the DSUs. The maximum size of the pumices was observed at Oguni town (North) and Taketa town (East). These areas located topographical barriers and change of the slope points. The pyroclastic flows stagnated temporarily and accumulated the large pumices at these areas. (The relationship between the maximum size of pumices and lithics and thickness of the deposit are planning to be examined). The gradual decrease of maximum size of pumices and lithic sizes with the travel distance suggests the basal accumulation of pumices and lithics from the turbulent pyroclastic flows.

Keywords: Aso4, Pyroclastic flow, facies, thickness, emplacement mechanism





Characteristics of lahar and avalanche from snowmelt in Mount Fuji

*Jiro Komori[1]

1. Teikyo Heisei University

In Mount Fuji, a large isolated mountain, mudflow disasters occur subsequent to major snow avalanches. Such avalanche and related phenomenon, in other words “slush lahar (Anma, 2007)” is found to be caused by contraseasonal warm weather with heavy rain of extratropical low in the Sea of Japan (Hirose, 1970). In addition, the climatic condition in case of the avalanche, it is clarified from the weather data of the summit and the piedmont area. This presentation shows a tendency to appearance of these pressure pattern based on long-term data in Japan Meteorological Agency. Furthermore, the author tries to explain the tendency of the collapse location and time of these avalanches, based on the data of field survey and seismic data of NIED in Mount Fuji.

Keywords: slash avalanche, volcanic mudflow, yukishiro, spatiotemporal trend, extratropical cyclone, ice layer

Vesiculation experiments of rhyolitic melt: constraints on the conditions for lava dome explosions

Mizuho Taniguchi[1], *Shumpei Yoshimura[1]

1. Department of Earth and Planetary Sciences, Hokkaido University

Background
Lava domes often explode violently after emplacement, causing pyroclastic flows (e.g., 1902 Mt. Pelee, 1973 Santiaguito, 1991 Mt. Unzen; Ui et al., 1999). Such explosions are considered to be triggered by overpressures developed in bubbles (e.g., Sato et al., 1992). Therefore, to predict dome explosions, it is necessary to investigate the vesiculation kinetics of silicic magma. Previous experimental studies investigated the kinetics of vesiculation of rhyolitic melt, but their experimental conditions are not necessarily adequate for lava domes, because their starting obsidian was too H_2O-poor (0.1 wt%; Bagdassarov et al., 1996; Ryan et al., 2015) or too H_2O-rich (1.8 wt%; Stevenson et al., 1997). In this study, we carried out similar experiments under the condition close to the inside of lava domes (H_2O contents and temperature), and applied the results to lava explosions.

Experimental
Starting material was rhyolitic obsidian obtained from Wada Pass (H_2O contents=0.59 wt%). A slab was prepared from a chank of obsidian, and it was heated in a muffle furnace at 750, 800, 850, 900 deg C for 15 min ~ 95 hours. After quenching, vesicularity was measured with image analysis.

Results
Vesicularity increased with heating duration. At first, vesicularity increased slowly. And then, it increased rapidly and reached the equilibrium vesicularity (estimated by assuming all H2O exsolved). The vesiculation rate was strongly dependent on temperature, and was high when temperature was high.

Discussion
The Avrami equation was applied to the time-vesicularity relation, and the rate constant was estimated for each temperature. The activation energy was calculated from the rate constant and temperature, and it was 304 (+/-9) kJ/mol. This value was much closer to the activation energy of viscous flow of the rhyolitic melt (338 kJ/mol, Giordano et al., 2008) than that of water diffusion (88 kJ/mol, Zhang et al., 2007). Therefore, the vesiculation is considered to be rate-limited by viscous flow.

Application to lava domes
Experimental results were applied to prediction of lava dome explosions. After emplacement, dome surface immediately cools and vesiculation ceases, and thus the overpressure dose not increase any further. On the other hand, in the dome inside, vesiculation proceeds smoothly because temperature is maintained high, and thus the overpressure soon decreases. In the intermediate region, temperature decreases slowly, and thus the vesiculation rate decreases slowly. As a result, the overpressure and the explosion potential are maintained for a long period. We modelled these processes based on thermal conduction and the temperature-dependence of vesiculation rate, and calculated the duration during which the risk of explosions is reduced. Calculation results showed that when initial temperature of lava dome is 900 degC, the duration is 5 hours. When initial temperature is 750 deg C, the duration is 11 days.

Keywords: vesiculation, lava, explosion

Geological identification of ash-fall particles of the Tenmei eruption of Asama volcano in distant area: An attempt at Abiko, Chiba

*Shingo Takeuchi[1], Shimpei Uesawa[1]

1. Central Research Institute of Electric Power Industry, Civil Engineering Research Laboratory, Geosphere Sciences

Volcanic ash-fall can reach a distant area and has great adverse effects on human health and society. Therefore, it is important to investigate properties of volcanic ash-fall of past eruption in extensive area for volcanic hazard assessment. However, thin ash-fall deposit in a distant point is not preserved as a visible layer. Instead, particles of ash-fall are mixed in topsoil. In order to examine whether ash-fall particles are detected by analysis for topsoil at a distant point, we investigate forest topsoil sampled at Abiko, Chiba. Old documents describing ash-fall phenomena in the Tenmei eruption of Asama volcano located ca. 150 km from Abiko are found in the Abiko and neighboring areas (Tsukui, 2011). In this paper, we report identification of ash-fall particles of the Tenmei eruption of Asama volcano, based on chemical analysis of glass composition. The particles of Tenmei ash-fall are free crystal (plagioclase, orthopyroxene and clinopyroxene) with fresh glass attached on the surface. The compositions of attached glass are consistent with those of groundmass glass in pumice lapilli sampled in proximal area. This feature is useful for identification and investigation on the properties of Tenmei ash fall, especially particle size, in extensive area.

Keywords: volcanic ash-fall, Asama volcano, volcanic glass

3D modeling around Aso crater with SfM of UAV

*Tatsuro Chiba[1], Hisashi Sasaki[1], Kenichi Arai[1], Mikako Sano[1]

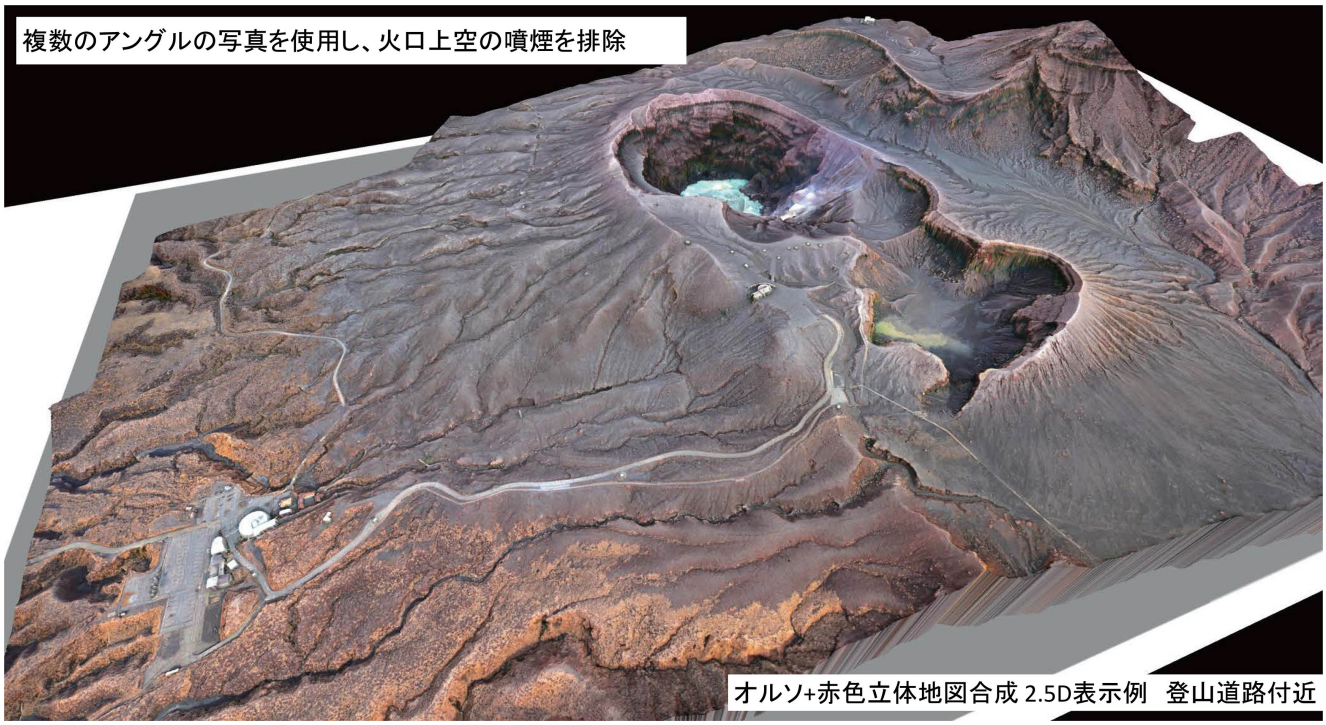
1. Asia Air Survey Co., Ltd.

1. Introduction
For volcanic disaster prevention, surveying situation near the crater just after eruption is very important. However, there is a risk of on-site investigation into the site and flight over the crater by a manned aircraft. For this reason, oblique photographing from a place away from the crater and laser measurement at high altitude have been performed. However, it was insufficient to capture detailed information near the crater. Although high resolution satellite photographs can be taken from directly above, there was a drawback that it is susceptible to the influence of clouds. To solve these problems, it is considered effective to take photographs from low altitude and create 3D models using unmanned aerial vehicles (UAV).

2. Mt. Aso volcano and UAV shooting
Mt. Aso erupted early on October 8, 2016. The erupted volcanic ash reached 11000 m above the ground and spread to the Shikoku area. From the image from the helicopter after the eruption, the volcanic bullets and ash fall were confirmed at the crater edge and its vicinity, the situation had changed completely. A big hole was found on the roof of the ropeway station building.
Therefore, in order to grasp the situation of 2 km square around the crater urgently, we took pictures using UAV. To create 3D models and grasp the damage situation, 5 or more images with ground resolution of about 1 cm are required per point. It was a single lens reflex with a full size CCD equipped with a 24 mm lens and it was necessary to keep the ground altitude below 350 m. Considering the payload of UAV and the duration of the battery, the flight time is 15 minutes / times, and it is necessary to take off from a safe place as close as possible to the crater. Therefore, we selected the parking lot in front of the station building under the ropeway as a takeoff point from the crater. The warning level became 3 after the eruption immediately, and that point was in a no-entry area. Then after discussing with the Aso Volcano Disaster Prevention Council, the Kyoto University Volcano Research Center, and the Meteorological Agency, we got a special permission for entry, and took pictures on December 8, two months after the eruption
.
3. Data processing and interpretation
A 3D model was constructed by SfM processing from 1,000 or more photographs taken. Furthermore, 20 cm DSM data and orthophotos were prepared, and topographical interpretation was carried out together with the red color map. At the valley near the crater, we were able to confirm the micro topography such as pyroclastic flow or mud flow, which seems to be a flow deposit.
Volcanic bullets and craters formed at the time of falling were also confirmed. On the other hand, due to gully erosion and secondary migration of descending volcanic ashes formed during the two months after the eruption, it was also confirmed that some of the craters were buried. Mt. Aso had erupted in 2015, and the calculation of the amount of blowout by comparison with the last topography is currently under construction because it requires the creation of a new model.
4. Future tasks
It took two months from the recognition of the eruption to the actual shooting. This is a major reason why it took time to consult with relevant organizations for access and to apply flight application and permission etc. In advance, the development of the aircraft, such as setting rules for emergency photography at the time of eruption or capable of autonomous flying over long distances and long hours

from outside the danger area is an issue. This work is part of MEXT projiect ,Integrated Program for Next Generation Volcano Research and Human Resource Development.

Keywords: UAV, SfM, Aso volcano



The case study of the volcanic disaster on Mt. Unzen and implications for disaster mitigation

*Daisuke Nagai[1]

1. Mt.Unzen disaster memorial hall

The dome building eruption of Unzen Volcano (1990-1995) displayed destructive aspects of Pyroclastic flows. The eruption resulted in the deaths of 44 people by pyroclastic surge. It is one of the most important problem to predict the risk from surges for hazard assessment. This study focuses on the impacts of surges and human injurer. A detailed analysis of the distribution and damaged houses of the surges on June 3, 1991 was used to study on the characteristics of surges. The result revealed that human injurer related the topographic effects of pyroclastic surge. Flow direction of the surge based on damaged trees and houses show a straight pattern from the Mizunashi River. But the direction changed a little after contact of mound of Mt Mayu. It is important study for future implication for volcanic hazard assessment.

Keywords: volcano, disaster

Development of a new tephra fall simulation code considering bending of eruption column under windy condition

*Kazutaka Mannen[1]

1. Hot Springs Research Institute of Kanagawa Prefecture

Today’s tephra fall simulation codes assume eruption columns that rise vertically from the source vent. This assumption is simple; however, under windy condition, eruption column bents in the downwind direction. The present advection-diffusion models, which assume relatively weak plume thus more or less fail to reconstruct observed thickness distribution. Tephra2, which is one of the most popular simulation codes, is not an exception.
Recently, several models that formulate column bending under windy condition have been proposed. Here I include bending of eruption column modeled by Woodhouse et al (2013) in Tephra2 and developing a remodeled code named wt (=windy tephra).
Woodhouse (2014) calculate coordinate of column center, column radius, upward velocity of the column, column temperature and etc. as a function of height. Tephra2 calculate coordinate of distribution center as a function of released height and particle diameter. wt calculate coordinate of distribution center based on column bending (Woodhouse, 2014) and atmospheric advection (Tephra2). Also, distribution width in Tephra2 is a sum of column radius and atmospheric diffusion. In wt, column radius is based on Woodhouse et al. (2014).
In the presentation, application of wt to the 2011 Shinmoedake eruption and the comparison of calculation results and observation will be discussed.

Keywords: Tephra2, weak plume, tephra fall simulation

Publication of a Japanese Website on the Protocol for Analysis of Volcanic Ash Leachable Elements

*Yasuhiro Ishimine[1]

1. Department of Health Crisis Management, National Institute of Public Health

I will report on the translation of the protocol for analysis of volcanic ash leachable elements of International Volcanic Health Hazard Network (IVHHN), which is revised in 2013, into Japanese and its publication on the Japanese website of IVHHN. Freshly-erupted ash contains a range of potentially toxic soluble elements, and thus, the public, civil authorities and agricultural producers will often have major concerns about the effects of volcanic ash on human and animal health, drinking water supplies, crops, soils and surface runoff following an eruption. As part of the immediate emergency response, there should be rapid dissemination of information about the physical and chemical properties of the ash and its hazardous potential. For example, some scientists received direct contacts from civil authorities in Oita prefecture and asked the degree of influence of volcanic ash on crops after the eruption of Aso volcano in October 2016. However, few Japanese scientists know the standard method for the rapid assessment of hazards from leachable elements, and as a result, we do not have a database, with which we quantitatively compare the toxicity of volcanic ash of each eruptions. The purpose of this presentation is to spread clear and reliable international standard protocol, which has been discussed in a workshop in Durhram, UK in 2011 and published in 2013 by IVHHN. The four applications considered in the protocol are (i) A ‘general purpose’ water leach, relevant to assessing impacts on drinking water supplies, livestock drinking water and fish hatcheries, and availability of soluble elements for plant uptake, (ii) Assessing ingestion hazards to livestock, (iii) Assessing ingestion hazards to humans, and (iv) Assessing inhalation hazards to humans. The adoption of standardized methods will improve and facilitate the comparability of results among different studies and enable the ongoing development of a global database of leachate information relevant for informing improved volcanic health hazards assessment.

Keywords: Volcacnic Ash, Leachable Element, Environmental Assessment, Analysis Protocol

Text mining analysis of newspaper coverage with volcanic disaster risk

*Kou Yamada[1]

1. Waseda University

Japan has been hit by many deadly volcanic eruptions. Public awareness of volcanic disaster risk and the volcanic risk reduction education are important to strengthen disaster preparedness for effective response. Mass media are one of primary channels in the permeation of expert knowledge to public. Mass media are therefore considered to have large influence on the public understanding of risk, leading to preventing and mitigating harm from volcanic disasters. Transmission of volcanic risk knowledge to public through media coverage is a key component of risk communication. During volcanic crisis, risk related information is frequently released through news media by experts or administrative agencies. Previous studies have paid attention on the risk communication in a short period just after large volcanic disasters. However, risk communication in peace time is also very essential in order to achieve the volcanic disaster reduction and risk awareness of citizen to the higher level and how volcanic risk related issues are framed by mass media in peace time as well as at the time of crisis remains still unsolved.
The Asahi Shimbun, Mainichi Shimbun, and Yomiuri Shimbun were chosen for this study. They are the representative national newspapers in Japan and have a circulation of several million. Almost all news articles published by these newspaper companies have been archived from the 1990s onward. These databases allow us to design the comprehensive research. Although it seems that volcanic risk may be the local problem, damages of volcanic ash widely spread once massive eruption occurs. In addition, an evacuation plan must be supported by not only municipality but also government. Thus, volcanic disaster risk can be a non-negligible national political concern. By examining the national newspaper, one can find which agenda related to volcanic disaster risk typical newspaper media extensively set as the national political concern.
The newspaper articles including two keywords “eruption” and “volcano”, which are published from January 1990 to December 2016, were selected, using these databases. The research methodology is the quantitative text mining analysis with the help of the LDA (Latent Dirichlet Allocation) which is a way of automatically extracting topics that texts potentially contain, on the base of distinctive patterns of lexical density. LDA can divide articles into several sub-groups of objects that share common characteristic and enables to identify volcanic disaster risk related articles. This study will exhibit when they are intensively distributed and what types of issues in the volcanic disaster risk are significantly framed by newspaper media. In this presentation, the feature that newspaper media mainly take up the volcanic hazard topic of Mt. Fuji will be presented.

Keywords: text mining, volcanic risk, mass media, news analysis

Prototype training program of the human resource development for volcanic disaster management officers at Mt Fuji

*Mitsuhiro Yoshimoto[1], Toshitsugu Fujii[1], Kenji Niihori[2], Konno Makoto[2], Setsuya Nakada[3], Masato Iguchi[4]

1. Mount Fuji Research Institute, Yamanashi Prefectural Government, 2. Organization of Volcanic Disaster Mitigation, 3. Earthquake Research Institute,The University of Tokyo, 4. Sakurajima Volcano Research Center, Disaster Prevention Research Institute, Kyoto University

The disaster management officers will change their working section each 2 to 3 year in Japan. If they respond appropriately to volcanic disasters, they need specialized knowledge compared to other natural disasters. However, they have to learn the knowledge of taking over form former officer when they start to work at the new section. We feel the need for a training program of human resource development that can respond accurately to volcanic eruption. We created a prototype training program based on interviews with the related organizations, and tried it in January 2017 at the northern foot of Mt. Fuji. The contents of the program consist of the lecture of volcanic eruption and disaster, actual eruption disaster responses and disaster prevention plan, and Disaster Imagination Game with a world cafe method. Finally, we carried out a questionnaire. As a result of the questionnaire, the people wish to take a training regularly, and they hope to attend such course once or twice per year. Especially they prefer to have it in the spring when they change the working section. We need to provide the lecture of volcano information released from the Japan Meteorological Agency and public information to residents as a future issue.

Keywords: Volcanic disaster, disaster management, training program

