Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

SVC52-01 Room:416 Time:April 28 10:00-10:15

Simulation of the Daisen-Kurayoshi tephra, in the San-in district, SW Japan, using Tephra2

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The Daisen-Kurayoshi tephra, which erupted from Daisen volcano at about 53 ka, is one of the most voluminous Plinian fall deposits in Japan. Its apparent volume was estimated as more than 20 km^3, but quantitative study of this tephra have not be done. So, we try to analyze this tephra using Tephra2 and decide its eruption parameters. In the simulation, we set 5 cases in height of the eruption column from 10 to 18 km, 4 cases in weight of the erupted magma from 1 to 8x10E+18 kg, 4 cases in medium grain size of the ejected materials from 0 to 3 phi, and 5 cases in sorting of the ejected material under the average wind data above Yonago. A total of 400 cases have been calculated. To explain the observed distribution of the tephra, the column height and ejecta weight have to be 18 km and 4 to 8x10E+18 kg (40 to 80 km^3), respectively.

Keywords: Daisen-Kurayoshi tephra, Tephra2

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SVC52-02 Room:416 Time:April 28 10:15-10:30

Insight into setup of typical meteorological conditions for evaluating volcanic ash hazard

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Estimation of ash concentration and deposition is of practical interest in evaluation of volcanic ash risk on critical infrastructure (e.g. Wardman et al. 2012). For estimating ash concentration and deposition, numerical simulations with an ash transport- and deposition-model have become a powerful tool (e.g. Folch 2012). However, the setup of meteorological conditions, which mainly control the ash transport- and deposition- processes in the atmosphere and on the ground, has not been discussed in details.

In the present study, we examine the estimation of ground deposition for a real test case, a volcanic ash hazard in Kanto-area for an eruption at Mt. Fuji, with various meteorological conditions by using an ash transport- and deposition-model, fall3d. The meteorological conditions are generated with the 53 years reanalysis meteorological dataset, CRIEPI-RCM-Era2, which has a temporal- and spatial resolutions of 1 hr and 5 km; the typical and extreme conditions were sampled by using Gumbel plot and an artificial neural network technique.

The ash deposition is invariably limited to the west area of Mt. Fuji, even with the typical wind conditions on summer, while the isopach of ground deposition depicted various distributions, which strongly depends on meteorological conditions. This implies that the concentric circular distribution must not be realistic. Also, a long-term eruption, such as the Hoei eruption during stage3, yields large deposition area due to the diurnal variations of wind direction, suggesting that the attention to the differences between diurnal variation and fluctuations of wind direction on evaluating of volcanic ash risk is vital.

More details will be presented in the presentation, and we believe that our study must be helpful to develop the numerical simulations for evaluation of volcanic ash risk.

Keywords: Ash transport- and deposition-model, Long-term meteorological reanalysis, Extreme value, Artificial neural network, Advection-diffusion, Numerical simulation

Japan Geoscience Union Meeting 2014
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SVC52-03 Room:416 Time:April 28 10:30-10:45

Numerical model of 3D ballistic trajectory for hazard assessments at Upper Te Maari eruption of Tongariro volcano in New

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Ballistic bombs and blocks are energetic pyroclasts deposited around volcanic craters. Hazard assessments of ballistic projectiles are important for people, buildings, and roads around vent especially in tourist and residential areas. Tongariro volcano, an active volcano in a popular national park in New Zealand, erupted August 6th, 2012 after one hundred years. By combining acoustic signals with eyewitness descriptions, five eruption pulses from fissures around Upper Te Maari crater were characterized and conditions of particle ejection were defined. A distribution of ballistic blocks was mapped from orthophotos and field campaigns. In order to clarify characteristics of ballistics at Tongariro volcano and assess future hazards, a numerical model of ballistics is modified and applied to the 2012 eruption. At first, 3D multiparticle model based on Discrete Event Simulation (DES) method is converted to the model based on semi-Lagrangian method to include an effect of air drag and gas flow around airborne particles. Initial conditions, such as ejection direction and speed, were calibrated to explain both spatial and size distribution of deposit bombs. Finally, an initial particle velocity of 200 m/s and gas flow velocity (constant) of 150 m/s are obtained as conditions of best fit. Furthermore, we applied this model to the assessment of future eruption regarding Tongariro Alpine Crossing, a walking trail in the national park frequented by ˜80,000 people each year. Impacts of two extreme eruption cases are simulated by the numerical model. Negligible probabilities of fatality along the TAC are found from a magnitude smaller eruption, similar in size to the November 2012 eruption. However, a magnitude larger eruption could result in higher probabilities in certain areas of the track which it would be unlikely to survive the eruption. Varying the input parameters from the calibrated model allows for the assessment of future ballistic hazard from larger and smaller eruptions of Upper Te Maari Crater. A possibility of applying this model to the assessment of Japanese volcanoes such as Mt. Fuji will be discussed.

Keywords: Ballistics, Hazard map, Numerical model, Volcanic eruptions, Hazard assessment, Tongariro Volcano

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SVC52-04 Room:416 Time:April 28 11:00-11:15

Estimation of locations and migration of debris flows on Izu-Ohshima Island on 16 Oct., 2013 by seismic amplitudes

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Typhoon 1326 (Wipha) with heavy rainfall caused severe damage at Izu-Ohshima Island on 16 October 2013 with large-scale debris flow, probably not only a single event but sequence of flows.

Seismic networks on Izu-Ohshima recorded the signals originated from those debris flows. At least five events of large amplitudes are recognized in continuous records of seismographs.

It is hard to estimate the location of such events with conventional methods of epicenter determination because of the difficulty to identify any seismic phase arrivals. We estimate the locations of the five events with spatial distribution of seismic amplitudes (Battaglia and Aki, 2003; Kumagai et al., 2010). In this method, after correcting the site effect of each station, the RMS amplitude of high-frequency seismic waveform is assumed to decay only with geometrical spreading and intrinsic absorption. Although amplitudes depend on radiation pattern of seismic waves, the isotropic distribution of amplitudes could be assumed at high frequencies because of the scattering effect by small scale heterogeneity in the crust (Takemura et al., 2009). The location of each event is derived as the point of the minimum residual between observed and calculated amplitudes of all the seismic stations. Before estimating the locations of the five events, we apply the band pass filter of 5-10Hz to each seismic record. We assume that the filtered waveform is composed of S body waves only, S-wave velocity is 1.44km/s, and Q=100 for intrinsic absorption. We limit the search range of each event only on the surface of the island. Site factors of stations are estimated by amplitudes of coda waves for regional earthquakes.

The estimated locations of all the five events are located in an eastern side of Motomachi district, where huge causalities were suffered, agreeing with the debris flow traces mapped carefully after the disaster occurred. In addition, the location is migrated to the west (i.e., from the volcano flank to the sea coast) within its duration time of 60-80 sec except for one event with small duration time. Such migrations may correspond to the flow of debris, with its speed about few tens km/h. Time series of source amplitudes, that is, the maximum value and duration time of each event show the variability of the debris flows occurred on Izu-Ohshima Island within several hours on that day.

Generally, seismic networks focused on volcanic activities are generally composed of stations of higher density than other seismic networks. The records of such dense seismic networks are useful to analyze not only earthquakes and tremor on volcanoes, but also debris flows or other disastrous events, as shown in this study. The present location method using the spatial distribution of seismic amplitudes is conceptually able to apply in quasi-real time, so it should be useful to early estimation of location and magnitude of various disasters in and around volcanoes.

Acknowledgements

We analyzed the seismic waveforms recorded in the networks on Izu-Ohshima Island which are operated by Earthquake Research Institute of the University of Tokyo, the National Research Institute for Earth Science and Disaster Prevention, and the Japan Meteorological Agency. We used the digital elevation model and topographical map images of Digital Japan Web System provided by the Geospatial Information Authority of Japan.

Keywords: distribution of seismic amplitudes, locations and migration of debris flows, Izu-Ohshima Island

Japan Geoscience Union Meeting 2014
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SVC52-05 Room:416 Time:April 28 11:15-11:30

G-EVER Next-generation Volcanic Hazard Assessment System

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The Asia-Pacific Region Global Earthquake and Volcanic Eruption Risk Management (G-EVER) is a consortium of geohazard research institutes that was established in Asia-Pacific region in 2012. G-EVER aims to formulate strategies to reduce the risks caused by earthquakes, tsunamis and volcanic eruptions worldwide. The G-EVER next-generation volcano hazard assessment working group is developing a useful system for volcanic eruption prediction, risk assessment, and evacuation strategy at various eruption stages. The assessment system is based on volcanic eruption history datasets, eruption database and numerical simulations. Eruption history datasets including precursor phenomena leading to major eruptions are important for the prediction of future volcanic eruptions. A high quality eruption database which contains compilations of eruption dates, volumes, and styles, is important for the next-generation volcano hazard assessment system. Formulating international standards on how to estimate the volume of volcanic materials is important to establish a high quality volcanic eruption database. GIS-based spatial distribution database of volcanic materials (e.g. Tephra and pyroclastic flow distributions) is important for accurate area and volume estimation and risk assessments. The volcanic eruption database is developed based on past eruption results, which only represent a subset of possible future scenarios. Therefore, numerical simulations with controlled parameters are needed for more precise volcanic eruption predictions. The ”best-fit” parameters of the past major eruptions in the world have to be estimated and the simulation results database should be made.

The use of the next-generation system should enable the visualization of past volcanic eruptions datasets such as distributions, eruption volumes and eruption rates, on maps and diagrams using timeline and GIS software. Similar volcanic eruption types should be easily searchable from the eruption database. Using the volcano hazard assessment system, prediction of the time and area that would be affected by volcanic eruptions at any location near a volcano should be possible using numerical simulations. The system should be able to estimate volcanic hazard risks by overlaying the distributions of volcanic deposits on major roads, houses and evacuation areas using a GIS enabled systems. The next-generation real-time hazard assessment system will be implemented with user-friendly interface, making the risk assessment system easily usable and accessible online.

Preliminary version of the next-generation volcanic hazard assessment system is available since June 2013. This can run energy cone simulations at any volcano in the world using ASTER Global DEM, and the links to major volcanic databases, such as Smithsonian, VOGRIPA and Quaternary volcanoes. Almost all volcanoes in the world can be evaluated using this volcanic hazard assessment system. Currently, the system covers more than 3200 Quaternary volcanoes worldwide. Links to major volcanic databases in the world are useful to examine eruption history in detail. Using Google and Bing maps as base maps provide more information for hazard evaluations. A hazard evaluation system using Titan2D will be available soon. Hazard assessment system using probabilistic analysis is also being planned in collaboration with INGV in Italy. This hazard assessment system is expected to be used for hazard mapping and risk management planning by government authorities and policy makers.

G-EVER Next-generation Hazard Assessment System URL (http://volcano.g-ever1.org/vhazard/HazardAssessment/)

Keywords: volcano, hazard, Asia-Pacific, G-EVER, simulation, database

Japan Geoscience Union Meeting 2014
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SVC52-06 Room:416 Time:April 28 11:30-11:45

An attempt to obtain empirical evidences for petrological assessment of volcanic activity based on magma database

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For Japanese volcanoes, high-quality databases of volcanic eruptions have been developed, for example Japanese active volcanoes (Kudo and Hoshizumi, 2006-) and one-million years chronology of volcanic eruptions (Hayakawa, 1996-). These databases involve eruptive age, eruption style and eruption magnitude, M. In contrast, it is often the case that properties of magma that caused these eruptions remain unrevealed. We have sampled and analyzed eruptive products of ca. 90 eruptions in Japan during the last one hundred thousand years and are constructing a database of magmatic properties (petrological properties), as a magma database. This database involves mainly large scale eruptions with M=4-8 and additionally recent small eruption of M=1-3. In the magma database, we estimate melt compositions, and phenocryst contents, which are important factors controlling physical properties of magmas, and thus eruption dynamics. Based on the magma database, we have attempted to obtain empirical evidences between these magmatic properties and eruption characteristics (eruption magnitude, eruption style and so on).

Examining relationship between eruption magnitude, M, and magmatic properties for ca. 100 eruptions, including 11 eruptions compiled in Takeuchi (2011), some relationships are found.

(1) Rhyolitic melt (>70 wt% SiO2)-bearing magmas (andesitic to rhyolitic magmas) caused M=4-8 eruptions. In contrast, basaltic to dacitic melt (<70 wt% SiO2)-bearing magmas (basaltic to dacitic magmas) caused M=1-5 eruptions.

(2) For rhyolitic melt-bearing magma, the maximum eruption magnitudes are correlated with phenocryst content. Phenocryst-poor magmas with 0-20 vol% caused caldera-forming eruption with M=8 at the maximum, where phenocryst-rich magmas with 20-50 vol% phenocryst have the maximum eruption magnitude with ca.6.

These empirical evidences suggest that petrological properties, such as melt composition and phenocryst content, are some level of constraint on eruption magnitude. Thus, petrological analysis of eruptive materials in early eruptive stage may contribute to constructing eruption scenario.

Keywords: magma, petrological analysis of volcanic rock, assessment of volcanic activity, database

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SVC52-07 Room:416 Time:April 28 11:45-12:00

Temporal variation (2011-2013) of the amount of CO2 dissolved in Lake Monoun, Cameroon

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Introduction

On 15th Aug 1984, the people living Lake Monoun, western Cameroon, heard a loud sound and experienced earth tremors. After the event, a deadly phenomenon occurred as 37 people were asphyxiated by gas that was discharged from the lake. Sigurdsson et al (1987) attributed the cause of the outburst of CO2 to landslide that plunged into the Lake's depth, which was CO2-charged. After a scientific consensus that proceeded from a similar phenomenon at Lake Nyos (100 km NW of Lake Monoun) in 1986, the explosive discharge of CO2 gas from lakes was named "limnic eruption". In 2001, the concentration of CO2 dissolved in Lake Monoun approached saturation at the depth of 50 m (Kusakabe et al., 2008), suggesting a possibility of recurrence of the limnic eruption if no preventive measures were taken. To prevent another limnic eruption, a degassing pipe was installed at Lake Monoun in 2003 (Halbwachs et al., 2004), and by 2009, the lake was almost free of dissolved CO2 and lost its natural gas self-lifting capability through the pipes. Recently we observed that concentration of CO2 has increased slightly in the bottom water. To avoid gas re-buildup in the lake, in 2013, we installed a solar energy driven system to artificially pump the CO2-rich water to the surface.

So far we have employed two methods (MK and CTD) to determine a reliable CO2 concentration profile in lakes.

The MK method (Kusakabe et al, 2000)

With this method, we determine CO2 concentration in lake water as follows. A disposable plastic syringe that contains 10 ml of 5M KOH solution is immersed in the lake at a given depth using an MK sampler. After that, we suck 30ml of lake water into the syringe to fix the total dissolved CO2 (CO2 dissolved gas, HCO3- and CO3–) as CO3–. Then a volumetric titration with standard HCl solution allows the determination of the total carbonate in the syringe. The results obtained so far indicate that the MK method is accurate and reliable. However, the method gives discrete data in terms of depth.

The CTD method

The CTD (Conductivity, Temperature, Depth) enables us to estimate the CO2 concentration as a smooth depth profile. The absolute value of CO2 concentration by the CTD method depends strongly on pH and conductivity values, thus the data from the CTD method need to be carefully examined compared to those from the MK method. We introduced an adjustable parameter k as defined by C-corr=k∗C, where C is the measured raw conductivity and C-corr is the corrected conductivity. Assuming an appropriate molar conductivity for HCO3-, the C-corr gives the total CO2 concentration under the assumption of chemical equilibrium among the dissolved carbon species (CO2aq, HCO3- and CO3–). We compared the total CO2 concentration by MK method and CTD method at the every depth where we have the values by MK method. The difference between the two methods was squared and the summation of squared values was calculated. The summation was minimized with changing the parameter k.

Results

As shown in Fig. 1, the thickness of bottom water with CO2 concentration higher than 20 mmol/L increased significantly in 2012 relative to 2011. This tendency continued in 2013, although CO2 concentration of the bottom water decreased slightly. The lake water shallower than 30m is affected by inflowing river water contains low concentration of total CO2. The total CO2 profile was integrated between -98m (near bottom) to -30m and estimate of the total amount of CO2 in the lake were 101, 118 and 119 Mmol in 2011, 2012 and 2013, respectively. Those values are much smaller than 600 Mmol, which was the amount of CO2 gas in lake just before the degassing pipe started functioning (Kusakabe et al., 2008). However, it should be noted the amount of dissolved CO2 is gradually increasing, so a regular monitoring of the lake is imperative.

Keywords: Lake Monoun, CO2, Limnic eruption, Cameroon, Magma

SVC52-07 Room:416 Time:April 28 11:45-12:00

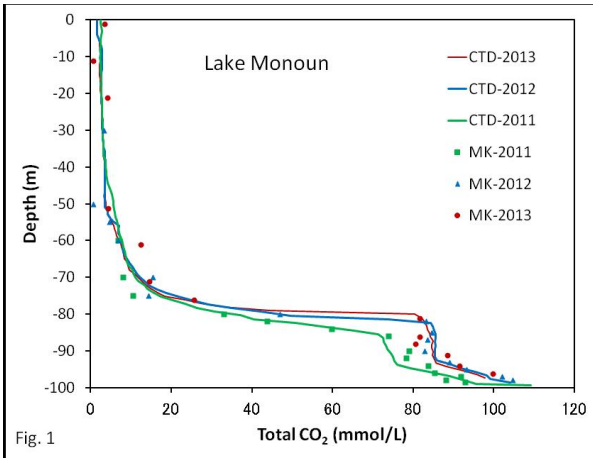

Fig. 1

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Topographical features of Fuji volcano as seen in the polar coordinate system

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Introduction

Fuji volcano is the highest mountain in Japan and the most active volcano in past 12 thousand years, in Japan except for the caldera eruption (Miyaji 1988) . The inclination is loosely about 300,000 people each year climb to the summit.

As a result of repeated eruption of central vent , volcanic body of a huge cone-shaped with a diameter of 10km high specific 2000m is formed around the crater . Fuji volcano had piled up in stages on Komitake , Old-fuji , and New-fuji. The remaining part of the old edifice also so as to project on the slope .Fuji is seen variety profile from the direction by such features .

Study range

In this paper , the technique of polar coordinate conversion. Study subjects ranged circular radius 13.5km centered summit. This point is not the highest point , the approximate center of Dainai-in Institute(The latitude is 35.36295 and longitude is 138.73035) . The terrain data is base map information 0.4 seconds mesh of the Geographical Survey Institute (about 10m) source , was used in resampled to 50m mesh japanese orthogonal coordinate system (VIII, system) .

Angle of repose

Slope gradient of the volcano , is determined by the movement mechanism and state of matter that has been brought to the ground from the crater in general , the angle of repose and stable gradient . Looking at the topography of the polar coordinate transformed , it can be seen that the portions to concentrated lateral cone is higher than ambient , and is raised as acne . In particular , it is found that it is concentrated in a direction 315 degrees and 135 degrees direction . It should be noted that the gap of advanced 250 degrees around , under the influence of Tanzawa is protruding from the east , to the south of Gotemba is lower .

Projected section

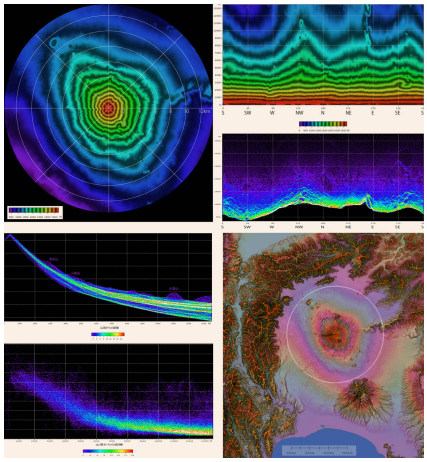
Take the elevation direction from the summit , the Y -axis in X -axis , to prepare a projected section shows the projection section color grid point frequency distribution of 50mDEM. If likened to Mount Fuji skirt , bright line of lower limit corresponds to the height of the perimeter of the flared skirt . According to this chart , it can be seen that the low altitude most Fujinomiya direction of southwest . Then , a Fuji-Yoshida direction Gotemba direction , finally . Design such as bubbling southeast and northwest direction direction can be seen , but it is the effect of mountain body side of the volcano . In addition, over the surface of Lake Yamanaka from Oshino of 250 degrees from 200 degrees azimuth , elevation is significantly higher than at the periphery . In this direction there is a mountain slope body of old Fuji.

Literature

Tatsuro Chiba (2010) Landform -50mDEM cylindrical coordinate transform analysis , Fujigaku studies , 7, 1 , 3 -13.

Miyaji Naomichi (1988) Activity history of younger Fuji volcano , Journal of the Geological Society ,94 , 6 , 433 -452.

Keywords: DEM, angle of repose, profile, slush abalanche, lava flow, active fault



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Tool handing down disaster experiences using Geoparks: examples of Unzen Volcanic Area Global Geopark

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Local inhabitants living in Shimabara peninsula has suffered volcanic disasters of Mt. Unzen repeatedly, which include the worst volcanic disasters occurred in 1792 (Kansei eruption and Shimabara Catastrophe). Nevertheless these conditions, they stay near Mt. Unzen to take good living environments.

Since they continue living in the near active volcano, they are always at risk of the volcanic disasters. If these experiences of disasters pass down to next generations, disaster prevention awareness in local inhabitants and, as the result, risk from disasters should be reduced. However, because of a long eruption interval (a few hundred years) of Mt. Unzen, it is difficult to pass down these experiences to next generations. Furthermore, the information that emphasized a disaster more than required may lead the uneasiness of local inhabitants. The system to overcome these problems is a Geopark.

Education is one of main component of businesses of geoparks. Thus, we have carried out an education program of disaster prevention for local school students as a business of Geopark and promote their awareness of disaster prevention.

Actually, all of 6th grade of elementary school students in Shimabara city visit geosites for a day as a geotour and learn the highlights of the Geopark. Main theme of the geotour is *a Kansei and Heisei eruptions and their disasters*. School students learn what happened at their home town in about 20 years ago through observation of a building of elementary school burned by a fire derived from pyroclastic surge and a memorial park preserved houses buried by lahar. In the tour, I also try to inquire why you stay near the active volcano introducing great landscapes created by big landslides occurred in 1792, spring water sprung out from a head of a lava flow emitted in 1792 and local special foods using local natural environments.

This is not a program to learn disaster prevention directly. However, when local inhabitants (especially children) understand academic value of local resources (e.g. strata, landscapes, human history, culture, and so on) and realize reasons to stay near active volcanoes, their consciousness of disaster prevention must be promoted. I believe the system of Geopark must contribute promotion of volcanic disaster prevention in Japan.

Keywords: Unzen Volcanic Area Global Geopark, Educatiion of disaster prevention, geosites, Heisei eruptopm, Shimabara Catastrophe