Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

HDS04-01 Room:102B Time:May 20 09:00-09:15

Deep-seated catastrophic landslides induced by typhoon 12 and their precursory gravitational slope deformation

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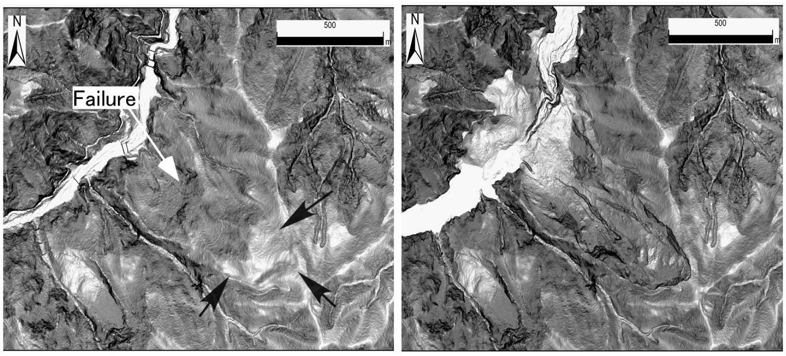
Typhoon 1112 crossed the Japanese Islands from 2 to 5 September in 2011, inducing more than 50 deep-seated catastrophic landslides of Jurassic to Palaeogene sedimentary rocks. These landslides hit houses, made landslide dams, or induced Tsunami by rushing into swollen rivers. The areas of landslides ranged from 36,000 m2 to 54,900 m2 and the maximum volume is estimated to be 15 million m3. Nine landslides have been surveyed by Lidar before the events as well as after the events, which clearly showed that eight of the 9 landslides had small scarplets near their future crowns beforehand as precursory topographic features. These scarplets are made by gravitational slope deformation that preceded the catastrophic landslides. The strains accompanying the deformation are estimated to be from 5 to 21 %, which suggests that these landslides were under the critical condition just before failure. Fourteen landslides we surveyed in the field had sliding surfaces along faults made during accretion or along bedding.

Lower photographs are slope images of Akatani landslide, one of the largest landslides induced by the typhoon. Comparing these images, we clearly identify scarplets along the future crown, which is indicated by black arrows. The landslide slope had a failure at the lower part beforehand, destabilizing the upper portion of slopes. Similar scarplets have been identified in most landslides before the events.

We acknowledge that the Kinki Regional Development Bureau of the Ministry of Land, Infrastructure, and Transport and Nara Prefectural Government to provide invaluable DEM data.

Keywords: deep-seated landslide, typhoon 12, slope development, geology, mass rock creep, gravitational slope deformation



Japan Geoscience Union Meeting 2012
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HDS04-02 Room:102B Time:May 20 09:15-09:30

Rainfall, slope instability, and deep-seated landslides in Kii Mountains Japan

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[1]Disaster Prevention Research Institute, Kyoto University

Prediction of deep-seated landslides by heavy rainfall needs combination of two complementary approaches that focus on geological and geomorphological predisposition of hillslopes, and hydrological triggering of final slope destabilization. Analyses of topography and rainfall history will provide a clue to understand processes leading to deep-seated landslides in mountainous landscape. This study reports the case of deep-seated landslides caused by typhoon 12 in 2011, in Kii Mountains, Japan. A GIS-based topographic analysis revealed the distribution of potential hillslope instability in the terrain, and hence offered an interpretation for location of the landslides. Timing and motion of several landslides are reconstructed by seismic-wave records. We examined relationships between preceding rainfall and volume or speed of sliding mass to evaluate threshold conditions leading to landslides.

Keywords: deep-seated landslide, rainfall history, landscape evolution, hazard zoning

Japan Geoscience Union Meeting 2012
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HDS04-03 Room:102B Time:May 20 09:30-09:45

Seismic recordings of the Landslides caused by Typhoon Talas

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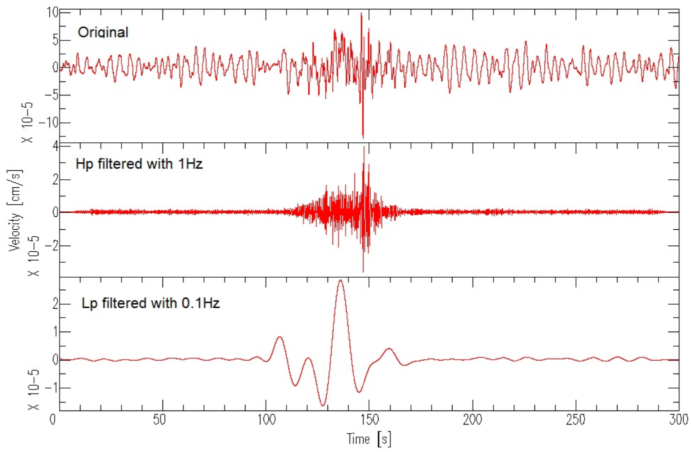
Typhoon Talas passed Japan Island on September 3-4, 2011 and brought substantial rainfall in western part of Japan. Total rainfall by this typhoon exceeds 2000mm in Kii peninsula, which caused many landslides in Nara, Wakayama, and Mie prefectures. 73 people were killed and 19 were reported missing by this typhoon.

The seismic signals due to these landslides are recorded by dense seismic network in Japan. The long-period surface waves are recorded by broadband seismic network (F-net) all over Japan (NIED, 2011), and short-period ground motions are recorded by the high-sensitive seismic network (Hi-net) as much as a few hundred km away. The landslide signals are usually tens of seconds long and have smooth onset, thus it is easy to distinguish to records of small earthquakes with couple of seconds duration. The typical landslide recordings are shown in Fig. 1, We applied back-projection technique (Spudich and Cranswick, 1984) to the records and determined the timing and location of each landslide signal.

We successfully detected several landslides in the continuous seismic recordings, and large events with volume more than 1 million m3 were located by the back-projection method. The seismic waveforms are very characteristic, and composed of high-frequency ground motion (frequency $>$ 1Hz) and low-frequency ground motion (frequency $<$ 0.1Hz). This complicated waveforms reflects the actual mechanism of landslides, and helps to understand the mass movement in time series.

The sequence of the landslides caused by Typhoon Talas can be located by the conventional source relocation technique in seismology. The seismic signal can tell the snapshot of the process of the landslides, which is rarely observed in visual (Suwa et al, Socio et al.). This is one of the most well-recorded landslide sequences all over the world. This seismic network is originally designed for locating seismic activities, but continuous records are very important to understand the mechanisms of the natural phenomenon as shown in this presentation.



Japan Geoscience Union Meeting 2012
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HDS04-04 Room:102B Time:May 20 09:45-10:00

Occurrence site of deep-seated landslides induced by typhoon 1112 in the Kii Mountains

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Distribution of convex slope breaks and fluvial knickpoints which are regarded as "erosion front" and deep-seated landslides induced by typhoon 1112 have been investigated to reveal how landslides develop in the context of long-term slope development. We analyzed mountain topography by using 10-m mesh DEM, topographic maps and aerial photographs in the central Kii Mountains, southwest Japan. We found that convex slope break is widely distributed about 200m above the present riverbed in study area, and it divides the area into lower dissected area and upper palaeosurface. Dissected area is divided into lower and upper parts by at least one slope break. These slope breaks were formed by active incision, and the incision dissected palaeosurface and propagated main stream to tributaries and downstream to upstream. Deep-seated landslides tend to occur in slopes with these slope breaks, because undercut slopes are unstable and partly suffered gravitational deformation. Topographic analysis by erosion front has the potential to identify the landslide-susceptible region roughly but widely.

Keywords: deep-seated landslides, erosion front

Japan Geoscience Union Meeting 2012
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HDS04-05 Room:102B Time:May 20 10:00-10:15

The geological characteristics of the Leye landslide near Alishan, Taiwan

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Serious landslides occurred in Leye region near Alishan, Taiwan in 2009 during Typhoon Morakot struck. This study investigated the mechanism of the Leye landslides and the characteristic of the nearby geological characteristics in the landslide area. The fluvial processes of the Tsengwen River should influence the landform thereby also influence the development of the Leye landslides. The landslide is triggered by the intense rainfall of Typhoon Morakot. Also, in the sedimentary formation of Leye region, the geological structures, such as synclines, anticlines and dip slopes control the displacement of the landslides. The mitigation works maybe helpful to retard possible complex the hazards in recent coming years. Emergency evacuation could be a better solution to mitigate the hazards in the Leye landslide area.

Keywords: Landslide, dip slope, mechanism, mitigation

Japan Geoscience Union Meeting 2012
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HDS04-06 Room:102B Time:May 20 10:15-10:30

Gravitational slope deformation induced by transient waves of incision in northern Taiwan

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At least 11% of the upper Shihmen Reservoir catchment is affected by gravitational slope deformation in the northern part of the Hueshan Mountain Range, Taiwan, where is underlain by Oligocene and Miocene sedimentary rocks and metamorphic rocks. The gravitational slope deformation has occurred as a response to the propagation of new incision waves to palaeosurfaces. Therefore, landscape evolution must be accounted for to predict and to evaluate potential sites of catastrophic landslides, most of which are preceded by gravitational slope deformation. Geomorphic analyses combined with cosmogenic nuclide dating revealed that at least three phases of transient waves of incision have propagated into paleosurfaces with a minimum age of ~140 ka. Tectonically induced base-level fall triggered the first incision wave around ~120 to 140 ka, dissecting palaeosurfaces and inspiring gravitational slope deformation. The second incision wave probably driven by global sea-level lowering during last glacial age has reached to the catchment around ~13 to 15 ka with an enormously rapid incision rate of 20 mm a-1, inducing slope movements. Climate forcing such as increasing monsoonal precipitation during the last glacial-to-interglacial transition may have been another cause of the rapid incision. The third incision wave is apparently associated with a local base level change. The trigger and its initiation are as yet unknown This younger incision made steeper slopes (avg. 39.8 degree), over several tens to a few hundred meters above current river bed. These are small landslide-prone slopes since numerous numbers of smaller landslides are concentrated on the lowest steep part of the river-side hillslopes.

Surface exposure dating on slip surface of an ancient landslide on a dip slope reveals the occurrence of the landslide in the late Holocene epoch, suggesting the development of the deep-seated slope deformation creates suitable conditions in a long-term (in the order of millions of years) for the subsequent landslide activities since the paleosurface has been dissected by the first incision wave. Recent catastrophic landslides had been preceded by gravitational slope deformation of rocks with adverse geological structures, suggesting that major-landslide prone slopes are dip-slopes of alternating beds of sandstone and mudstone at the margins of the paleosurface.

Keywords: gravitational slope deformation, transient waves of incision, paleosurface, cosmogenic nuclide dating

Japan Geoscience Union Meeting 2012
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HDS04-07 Room:102B Time:May 20 10:45-11:00

In-situ self potential measurement for monitoring of landslide process

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Recently, rainfall-induced landslides occur frequently. In order to mitigate landslide disasters, understanding of the landslide process and developing of early warning is important. In this study, self-potential (SP) approach has been attempted to develop an early warning system for rainfall-induced landslides. The laboratory experiments of landslides under the controlled artificial precipitation and a sandbox have been performed. Their results show the capability to monitor the subsurface water condition using the self-potential method. However, laboratory experiments have limitations in scale and soil layers. Therefore, it is necessary to verify the obtained results by a field (in-situ) experiment and we selected landslide site in Pelabuhan Ratu, Indonesia as a field experiment site.

In August 2010, we installed 39 non-polarizing (Pb-PbCl2) electrodes at 13 points. At each point, we buried the electrodes at a depth of 1.0m, 2.5m and 4.0m. And in order to check the relationship between self potential and water or soil displacements, 25 tensiometers, two borehole to measure tilt and a rain-gauge have been installed.

From the observed data, there is linear relationship between SP and pore water pressure. And electrokinetic coupling coefficient was yielded about -2.0 mV/m using this linear relationship.

It's recognized that SP changes in association with rainfall have been recorded at the site. We consider that these changes are caused as the result of groundwater flow. In order to check the groundwater flow, we calculate the electrical potential differences between neighboring two electrodes. The groundwater flow almost vertical direction in low rainfall day. In heavy rainfall day, the lateral flow dominates in the slope profile. And we calculate the hydraulic gradient using SP data and electrokinetic coupling coefficient. The hydraulic gradient of lateral direction tends to increase associated with heavy rainfall. From the indoor landslide experiment, the groundwater flow changes from vertical direction to lateral direction 20 min before the main collapse. Therefore, it indicates that the capture lateral flow might be connected with landslide process. The details will be provided our presentation.

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HDS04-08 Room:102B Time:May 20 11:00-11:15

Statistical emulation of a landslide-generated tsunami model

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Due to the catastrophic consequences of tsunamis, early warnings need to be issued quickly in order to mitigate the hazard. Additionally, there is a need to represent the uncertainty in the predictions of tsunamis' characteristics corresponding to the uncertain trigger features (e.g. either position, shape and speed of a landslide, or sea floor deformation associated with an earthquake). Unfortunately, computer models are expensive to run. This leads to significant delays in predictions and makes the uncertainty quantification impractical. Statistical emulators run almost instantaneously and may represent well the outputs of the computer model. In this paper, we employ the Outer Product Emulator to build a fast statistical surrogate of a landslide-generated tsunami computer model. This Bayesian framework enables us to build the emulator by combining prior knowledge of the computer model properties with a few carefully chosen model evaluations. The good performance of the emulator is validated using the Leave-One-Out method.

Keywords: landlslide, tsunami, statistical emulation, hazard assessment

Japan Geoscience Union Meeting 2012
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HDS04-09 Room:102B Time:May 20 11:15-11:30

TSUNAMI GENERATION BY GRANULAR LANDSLIDES IN VARIOUS SCENARIOS

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Tsunamis generated by landslides and volcanic island collapses account for some of the most catastrophic events. Major tsunamis caused by landslides or volcanic island collapse were recorded at Unzen in 1792, Krakatoa in 1883, Grand Banks, Newfoundland in 1929, Lituya Bay, Alaska in 1958, Papua New Guinea in 1998, and Java in 2006.

Source and runup scenarios based on real world events are physically modeled in the three dimensional NEES tsunami wave basin (TWB) at Oregon State University (OSU). A novel pneumatic landslide tsunami generator (LTG) was deployed to simulate landslides with varying geometry and kinematics. The LTG consists of a sliding box filled with up to 1,350 kg of naturally rounded river gravel which is accelerated by means of four pneumatic pistons down the 2H: 1V slope, launching the granular landslide towards the water at velocities of up to 5 m/s.

Topographical and bathymetric features can greatly affect wave characteristics and runup heights. Landslide tsunamis are studied in different topographic and bathymetric configurations: far field propagation and runup, a narrow fjord and curved headland configurations, and a conical island setting representing landslides off an island or a volcanic flank collapse.

Water surface elevations were measured using an array of resistance wave gauges. The granulate landslide width, thickness and front velocity were measured using above and underwater cameras. Landslide 3-dimensional surface reconstruction and surface velocity properties were measured using a stereo particle image velocimetry (PIV) setup. The speckled pattern on the surface of the granular landslide allows for cross-correlation based PIV analysis. Wave runup was measured with resistance wave gauges along the slope and verified with video image processing. The measured landslide and tsunami data serve to validate and advance 3-dimensional numerical landslide tsunami and prediction models.

Keywords: landslide, tsunami, volcano

HDS04-10 Room:102B Time:May 20 11:30-11:45

Debris flow hazards in Malaysia: The need for comprehensive mapping and risk assessment

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Debris flow is quite common in hilly and mountainous areas. In Malaysia, it is the life-threatening landslide disaster, the type of landslides that killed many lives compared to other landslide types. While many natural debris flows have occurred in areas without human settlement, there were at least 15 cases of killer debris flows since year 1994, at least 137 people were killed. Several major debris flows events in Malaysia were (1) a multiple-landslide cum debris flow flooded a major highway in Genting Sempah, Selangor killed 21 road users that were in their idling vehicles when the road was blocked by a small landslip. The debris flow started from landslides at the headwaters of the steep mountain flanking the highway; (2) a debris flow devastated a local village in Pos Dipang, Perak in 1996, 44 people died. The debris flow nucleated by several landslides in the upper valley scouring the valley, subsequently created temporary dams along the river before the village. The village was eventually swept away by overwhelmed debris flood when the temporary dams broke; (3) in Johor, Vamei-Typhoon storm with the strength that capable of uprooting trees and heavy rain attributed to several induced landslides then debris flow in Gunung Pulai in the year 2001. Four houses were swept away by the debris flood and 5 were killed, due to debris accumulated before a bridge across the river broke, and; (4) in 2002, 16 lives perished when debris flow buried their village in Ruan Changkul, Sarawak. It buried an 8-unit long house, the 20,000 cubic meter debris was initiated from a landslide on the agricultural land on top of the hill. More recently, in August 2011, a debris flow in Sungai Ruil, Cameron Highlands buried 4 houses at a foot slope, 7 killed while 2 injured; the houses were situated 150m away from the source of the landslide.

In Malaysia, the debris flow landslide is becoming an alarming disaster as development are encroaching the fringe of highlands and mountainous areas. The hazards from the adjacent slopes or upstream located far away has yet to be considered in many risk assessment. Only a limited mapping and identification of debris flow were carried out at very local scale while there are many places in Malaysian topography of mountainous and dissected hilly terrain are vulnerable to debris flow. Currently, research on debris flows in Malaysia is still very limited to post-disaster investigation within the areas of debris flow where disasters occurred, particularly if death is involved.

A nation-wide mapping is proposed to be carried out to delineate areas of potential and vulnerable to debris flows. The first level of national mapping will rely on topographical and geological data to identify elements that are susceptible to debris flow with emphasising on the basin geometry, geomorphology, modelling of run-out distance of a debris flow and at-risk cultural elements.

Keywords: debris flow, landslide, Malaysia, debris flood

HDS04-11 Room:102B Time:May 20 11:45-12:00

Monitoring of the rapid weathering in a badland of Plio-Pleistocene mudstone area, southwest Taiwan

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We monitored water contents and electric conductivities beneath a slope surface in a badland, southwest Taiwan, where highly incised topography is formed by rapid erosion of about 10 cm/year on Plio-Pleistocene mudstone. Badland is characterized by dissected bold landscape with gullies and ridges. It is widely distributed in arid to semi-arid areas in the world (ex. South Dakota in America, Loess area in China, south Italy and southeast Spain). Slope surface in badland of weak mudstone is markedly characterized by surface crusting and desiccation cracks, which reach 10 to 20 cm depths. Erosion in such badlands is assumed to be related to high saline contents. We set sensors for temperature, water content, and electric conductivity at 0 to 40 cm depths beneath a slope surface and measured them at 10 minutes intervals from 2009 to 2011. A rain gauge was set 1 m above the ground in front of the monitoring slope and hygro-thermo meters were set 10 cm above the slope surface and with the rain gauge. About 1900 mm of precipitation occurred during the monitoring interval and over 96% of the rainfall was in the rainy season from May to September. Air temperatures and relative humidities gradually increased to rainy seasons from dry season. Water contents near the slope surface were lowest in the dry season and increased by infrequent rainfall events, and became quite high in rainy seasons. Salinity, which is estimated from electric conductivities and water contents, near slope surface was lowest in dry seasons and increased in early rain seasons. The increased salinity was diluted by heavy rainfall events in rainy seasons and intensive erosion occurred by the grain dispersion by the dilution. Water penetration depths were 30 to 40 cm in dry seasons and became much shallower to a depth of about 10 cm in rainy seasons. The decrease in the water penetration depths may be attributable to the self sealing of cracks by rock expansion when wet.

Keywords: badland, Plio-Pleistocene mudstone, rapid erosion, weathering, salt movement, monitoring

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HDS04-P01 Room:Convention Hall Time:May 20 17:00-17:45

An application of the diffusion and advection equations for the evolution of a gravel slope

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The diffusion and advection equations were manually coupled to model the evolution of a gravel slope in Da-keng, Taichung, Taiwan. The two equations were discretized using finite difference method and coded in Matlab environment. Field topographical surveys of the gravel slope and previous digital terrain data were used for calibrating the diffusion and advection coefficients used in the equations. We show that the evolution of slope decline and parallel retreat can be well described the gravel slope evolution in Da-keng. A non-homogeneous slope was simulated by varying the corresponding diffusion and advection coefficients for the non-homogeneous slope.

Keywords: Slope evolution, diffusion model, advection model

Japan Geoscience Union Meeting 2012
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HDS04-P02 Room:Convention Hall Time:May 20 17:00-17:45

Fluctuation in excess pore water pressures triggered by earthquakes at the Busuno landslide

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1.Introduction

There are not many observations in pore water pressure induced by earthquake (EQ) at a landslide area. We observed seismic motions and coinstantaneous pore water pressures in a landslide area, and considered their relationships in some aspects.

2.Seismic motions and pore water pressures for analysis

We installed some piezometers at the Busuno landslide area in Niigata Prefecture, and observed five fluctuations in pore water pressures corresponded to following earthquakes: the Niigataken Chuetsu Earthquake in 2004 (EQ1), the strongest after shock of EQ1 (EQ1'), the Niigataken Chuetsu-oki Earthquake in 2007 (EQ2), the Naganoken Hokubu Earthquake in 2011 (EQ3) and the strongest after shock of EQ3 (EQ3'). Since we started a seismic observation from 2010 at the Busuno landslide site, the strong motions by EQ1 to EQ2 were estimated based on that from National research institute for earth science and disaster prevention K-net Yasuzuka (NIG 024). To estimate the peak ground acceleration and peak velocity acceleration of the Busuno landslide, we have adopted the attenuation relationships using the shortest fault distance (Si and Midorikawa, 1999). Five piezometers were installed at the middle block from 2002, and observed pore water pressures for EQ1, EQ1' and EQ2 every 10 minutes. Since they were broken by heavy snow in 2005, two were newly-installed and observed them for EQ3 and EQ3'.

3.Results and discussions

All piezometers showed ?uctuations in pore water pressures at the time of five earthquakes. For EQ1, EQ1, and EQ2, the pore water pressures showed spike-like fluctuations by receiving rapid elastic compression in the low permeability layer. The pore water pressures fluctuated larger as the peak acceleration becomes larger. The highest peak ground acceleration was observed by EQ3 (NS 236 gal, EW 382 gal and UD 108 gal with a dominant frequency of 3Hz), and the largest rise in pore water pressure (15 kPa) was observed. Other earthquakes caused much lower fluctuations in pore water pressure less than 1 kPa even in maximum. We considered the possibility of a snow pack effect on the slope. The landslide area was covered by around 3 m depth of snow when EQ3 occurred (March, 12, 2011). Therefore, higher pressure acted on the sliding surface during EQ3. Okamoto et al. (2006) reported that the high pore water pressures remained for 8 to 24 hours both after EQ1 and EQ2 at the site, and referred that was because it was consisted of two components which are the transform elastic compression (spiking ?uctuations) and the plastic compression (remaining high pressure) of the ground at the time of the earthquake. The similar fluctuations were observed by EQ3 and EQ3'

References

Si, H., Midorikawa, S., 1999. New attenuation relationships for peak ground acceleration and velocity considering effects of fault type and site condition. J of structural and construction engineering. Transactions of AIJ (523), 63-70.

Okamoto, T., Matsuura, S., Asano, S., Takeuchi., 2006. Displacement and fluctuation in pore water pressure of active landslide area by the Mid Niigata Prefecture Earthquake. J. Jpn Landslide Soc. 43(1), 20-26.

Keywords: landslide, earthquake, excess pore water pressure, peak ground acceleration

HDS04-P03 Room:Convention Hall Time:May 20 17:00-17:45

The sandbox experiments to understand Self-Potential changes associated with water flow

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Landslides are one of the most severe natural disasters in the world and there are two types; rainfall induced landslides and landslides triggered by an earthquake. In this research, basic study on early warning system for landslides will be performed to understand rainfall-induced landslide process by hydrological and electromagnetic changes. The final goal of the research is to develop a simple methodology for landslide monitoring/forecasting using self potential method. Conventional methods for monitoring landslides are based on geotechnical and hydrological approaches measuring pore pressures and displacements on the surface. In these methods, boreholes are required in general which may disturb the subsurface water system. Making boreholes is costly and it is not so practical for field applications. On the other hand, self potential measurement using two electrodes is easy to set up and run continuously.

In this study, the sandbox experiment has been conducted to understand the relation between water flow and self potential using a network of electrodes set in the tank. For the sandbox system, it is possible to control the water table and easily to drain water from the tank and infiltrate water into the tank. Controlling water flow in the tank, we conducted repeatedly experiments. In consequence, we could get the relation between the magnitude of water flow and self potential. The details will be given in our presentation.

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HDS04-P04 Room:Convention Hall Time:May 20 17:00-17:45

Geometry and pattern of slope failures at a fault scarp in analogue models

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A slope failure, which damages to human lives so much, is a natural phenomenon that a slope instabilized by geological and geomorphological factors is collapsed induced by torrential rain and earthquake motion. Therefore analyzing each factors related to slope instabilization and evaluating the risk of slope failures, are very important for preparing future torrential rains and earthquakes. In our research, we focused on the reverse fault, which is one of geological factors of slope failures, and performed analogue model experiments with dry sand to examine slope topography, development and failure induced by reverse fault activity. In the experiments torrential rain was reproduced, and the experiments were conducted in static condition so that influences such as earthquake motion could be ignored; we could consider only the activity of a reverse fault to evaluate the influences on slope development and failures.

In our experiment, a slope was reproduced that developed on the surface of the sedimentary layer on a basal rock. Wooden rigid blocks cut at the angle of 30 degree were put on the lower part of the experiment apparatus as basal rock, and dry sand is piled on the blocks. Reverse fault displacement was given to these blocks and a slope was induced on the surface of dry sand. During the experiment, slope development and failures are recorded with digital cameras from side and upside of the model at even intervals. The time series deformation process of the model was obtained by analyzing taken digital images using digital image correlation (DIC) technique, and 3D slope topography, patterns of slope failures and fault activity in cross section were related with each other.

The observation of 3D slope topography revealed that a steep area with constant width was at the foot of the slope regardless of slope length, or the level of slope development. On the other hand, fault activity, which is visualized by analyzing images taken from the side of the model, was always localized at the foot of the slope with constant width near surface. These results are very consistency, which suggests that specifying a steep area from slope dip distribution enable us to estimate the position and width of fault under a slope.

The generated slope on the dry sand was not linear but had certain curvature. On the area of the slope convex toward the hanging wall, hanging wall displacement was large and many large slides occurred, which are defined generate at the top of the slope accompanied with large failure areas, and vice versa on the area convex toward the foot wall. As the hanging wall displacement increased and the slope developed, the topography of the top of the slope deformed into one of emphatic initial slope curvature, while the foot of the slope increasingly became flat. Observed phenomena, including large slope failure, seem to be dependent on the initial slope curvature, which suggests the possibility that slope curvature on surface is applicable for quantification of the risk of large slope slide.

Keywords: analogue modeling, reverse fault, slope failure, DIC, 3D topography

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HDS04-P05 Room:Convention Hall Time:May 20 17:00-17:45

3D remote-sensing study of the spatial distribution of landslides in SE Weihe Basin, central China

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Many factors may be responsible for the occurrence of landslides, such as moderate to large magnitude earthquakes, typhoons as well as human activity. The landslides triggered by the earthquake are mostly concentrated in and around the epicentral area of large earthquakes over a distance of tens of kilometers, as well their distribution is strongly affected by the seismic faulting (e.g. Ren and Lin, 2010). To learn the distribution of landslides and its controlling factors is vital to make the risk assessments of landslide hazard, especially within the seismic active region.

Remote-sensing techniques have been applied to learn the spatial distribution of co-seismic landslides, based on cross-check of the refection features of images acquired before and after the earthquake. Meanwhile, Digital Elevation Model (DEM) data with world-wide coverage (e.g. 90-m SRTM data) were also used to learn the topographic features of locations where landslides occurred (e.g. Ren and Lin, 2010). However, most of by previous studies are limited to analyze in map-view. Here we present a case study of the distribution of landslides and its relation to the active normal faults in SE Weihe Basin, central China, by using the 3D remote-sensing techniques which has been previously applied to detect the locations of seismic faults associated with moderate to large magnitude earthquakes.

In this study, higher resolution remote-sensing images (1-m IKONOS and 0.5-m WorldView data) were processed and analyzed in 3D perspective views by draping them on the 30-m ASTER Global Digital Elevation Model (ASTER GDEM) data. High-resolution Google Earth images if available were also used to cross-check the spatial distribution of landslides. Based on the results of our analysis, we then conducted the fieldwork to validate the interpretations of the remote-sensing images.

The results of our analysis indicate that the landslides are mostly distribution in the regions between the Weinan and Huayin city, which was inferred as the epicentral area of 1556 M8.5 Huaxian earthquake. Meanwhile, the landslides (including the largest Lianhuashi and Zhangling landslides) are generally developed upon the steep slopes (30^o-65^o) within a narrow zone with width of ~8-11 km and ~3 km along the Huashan Piedmont Fault and Northern Margin Fault of the Weinan Loess Tableland, respectively. The distribution of landslides was affected by the active faults and slope morphology in study area. The devastating 1556 M8.5 Huaxian earthquake caused widespread damages in the densely-populated region around the Xi'an city, an old capital of China, resulting in more than 830,000 deaths (largest total ever claimed), including the people killed by the giant landslides (e.g. Zhangling landslide). 3D remote-sensing techniques show their advantages to precisely constrain the spatial distribution of landslides and thus make the risk assessment of landslide hazard in the seismically active regions, such as the SE Weihe Basin.

References cited:

Ren, Z. & Lin, A. 2010. Co-seismic landslides induced by the 2008 Wenchuan magnitude 8.0 Earthquake, as revealed by ALOS PRISM and AVNIR2 imagery data. *Intern'l J. Remote Sensing* **31**, 3479-3493.

Keywords: landslides, active normal faults, 3D remote-sensing, SE Weihe Basin, central China

HDS04-P06 Room:Convention Hall Time:May 20 17:00-17:45

Topographies of hazardous events on the bottom of Caldera Lake Kussharo, Hokkaido, Japan

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There are a lot of large caldera lakes in volcanic arcs such as Japan. Caldera lakes and their surroundings have good sceneries and hot springs; a lot of resorts located in their lakesides. However, the existence of abundant water in high elevation may provide the risk of the residences around the caldera lakes. The reasons are as follows: volcanic activities exist on the bottom of caldera lakes in many cases, and the inside of caldera rim is steep slope with large difference in elevation, their rims consist of lava and pyroclast which is preferred geology for catastrophic landslides. Volcanic activities and catastrophic landslides may cause overflow of lake water or tsunami. Their risk should be analyzed.

We are trying that analysis for Lake Kussharo in Hokkaido. Lake Kussharo is located in Kussharo Caldera which is the largest caldera in Japan. The lake has 79.3 km^2 in areas. The elevation of water surface is 121 m a. s. l. Only one river, Kushiro River flows from the lake to the downstream to Kushiro city. The resort area, Kawayu hot spring resort town is developed along lakeside. Volcanic activities are still active in this area. Mt. Atosanupuri erupted during the last few thousand years. The caldera rim has steep slopes and the highest part is 1000 m a. s. l. There are a lot of topographies of huge landslide masses and huge horseshoe shaped cliffs on the slope of rim. The terraces of old lake bottom lie on the wide area from the lakeside to the level of 150 m a. s. l. In addition, we found old terraces at the level of ca. 105-110 m a. s. l. and 95-90 m a. s. l. by our sonic survey. These terraces suggest that the level of water surface has repeatedly fluctuated.

We surveyed topography and geology of the ground surface and the bottom of lake using the sonic survey. In this presentation, we will mention about characteristic topographies related to past hazardous events. In particular, we found the mound-like hills in two areas. One area is ca 1 km in width from north to south and ca 1.5 km in length from east to west. This area has many small mounds, and their maximum size is ca 400 m in width and 20 m in height. Another area is ca 1.2km in width from north to south and ca 0.7 km in length from east to west. This area has also many small mounds, and their maximum size is ca 50 m in width and 20 m in height. These two areas are close to Nakajima Island which is the central cone of caldera. So, we deduce that both mound-like hills were flowed from Nakajima Is. by huge collapses. Also we found other topographies related to past hazardous events: landslide debris extended ca 2.5 km in width and ca 0.5 km in length near lakeside; a landslide involving bedded sediment; small eruptions with lava having width of ca 100 m; and topographies of depression associated with volcanic activities.

There are a lot of landslide masses and horseshoe shaped cliffs on the slope of rim. However, we could not find remains on their feet. Thus, most of their topographies on the rim do not concern recent hazardous events. The topographies we found are clear, so they probably formed after the formation of lake. Hazardous events formed their topographies could cause flood or tsunami, and then further events may occur around caldera lakes. Their risks should be considered for disaster prevention.

Keywords: Caldera lake, Landslide, Natural hazard, Lake Kussharo, Sonic survey