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

HDS027-P01 Room:Convention Hall Time:May 24 16:15-18:45

Effect of geology on the landslides by the Iwate-Miyagi Inland earthquake in the upper reach of Ichihazamagawa River

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[1]FFPRI, [2]Tohoku Regional Forest Office

We studied on the stratigraphy and geological structure by field survey and interpretation of airbone LiDAR DEM for the upper reach of Ichihasama River, where many landslides occurred by the 2008 Iwate-Miyagi Inland Earthquake. The Quaternary Kitagawa Tuff with high density and many cooling joints acts as caprock which was underlined by the Tertiary soft and low density sedimentary rock (Onomatsuzawa Formation).

In the northern part of the study area (north of the mouth of Kawaragoya-zawa River), ancient mountain landform was buried by the Kitagawa Tuff and the base level of the caprock was significantly high, which presumably brought about many large deep-seated landslides by the earthquake. Most of the deep-seated landslides by the 2008 earthquake have occurred on the steep slopes along the rivers and no large landslide occurred on geological dip slope, which has prevailed in Aratozawa and Koei Areas. The roughness of the caprock basal plane has affected on the motion of mountain slope to the characteristic features of the landslide.

Keywords: Iwate-Miyagi Inland Earthquake, landslide, caprock, GIS

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HDS027-P02 Room:Convention Hall Time:May 24 16:15-18:45

Topographic characteristics of mountain slope where landslide induced after 2008 Iwate-Miyagi Nairiku Earthquake

Wataru Murakami[1*], Yasuhiro Ogawa[1], Hiromu Daimaru[1], Fumitoshi Esaka[2]

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Authors have reported that landslide induced newly by the rainfall during 3 months after the 2008 Iwate-Miyagi Nairiku Earthquake, and moreover that cracks induced by the earthquake existed around the new landslide. This report introduces about the topographic characteristics of mountain slope where landslide induced after the earthquake by comparing shaded-relief maps and 1 m-contour maps made from the LiDAR data at two times (immediately after the earthquake and passed the earthquake 3 months), and the result of the field survey, on Tsukinokidaira area of Ichinoseki city, Iwate prefecture.

The micro-topography before the landslides induced after the earthquake occurred was interpretated, by the shaded-relief maps and 1 m-contour maps made from the LiDAR data. As the results, the spots where the landslides occurred after the earthquake was the convex, semi-circular, or horseshoe-shaped low gradient slope area. Such micro-topography was interpretated on several slopes where the landslide had not been generated yet. From the field survey, the occurrence of the cracks was found on these slopes. Around one of these cracks, simple penetration test was carried out. As a result, a weak layer existed in the depth of 2 m from surface in the slope below the crack. Thus, it was guessed that the weak layer was formed with the occurrence of the crack at the earthquake and it had led to the landslide by the rainfall after the earthquake.

Keywords: landslide, crack, LiDAR, low gradient slope area, simple penetration test, Iwate-Miyagi Nairiku Earthquake

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HDS027-P03 Room:Convention Hall Time:May 24 16:15-18:45

Evaluation of earthquake-induced landslide by using multivariate analysis

Bateer Hasi[1*], Kiyoteru Maruyama[1], Akira Nakamura[1], Tomoyuki Noro[1], Yoshifumi Hara[1]

[1]PWRI, Japan

Recent years, a series of strong earthquakes attacked Japan and surrounding regions, caused serious damages, such as destroyed lifelines and blocked rivers due to earthquake-induced landslides. The landslide susceptibility analysis is a method to reduce the landslide damage accompanying strong earthquakes. This study purposes to evaluate earthquake-induced landslide, by focusing on topographical factors using logistic regression analysis. We focused on pre-existing landslide topographies, according to the result that more landslides occurred within pre-exiting landslide topographies by the Mid-Niigata earthquake (Has et al., 2009), and the landslide topographical interpretation data are available. In this analysis, we used the landslides data from the Mid-Niigata earthquake in 2004 and the Iwate-Miyagi Inland earthquake in 2008.

Logistic regression analysis is a type of predictive model can be used when the depend variable is categorical and dichotomous. In this study, the landslide occurred /non-occurred is categorical data as dependent variable, and the geomorphological factors that influence landslide occurring are independent variables. Here, we selected surface roughness (the largest value of elevation difference within landslide topography), marginal erosion ratio (the erosion condition around the landslide topography; see Suzuki et al., 2010), slope gradient, mean curvature, distance from ridge line as independent variables which considered to be the influencing factors for landslide induced by earthquake. In this study, we only selected geomorphological factors but did not select geological factors, because the considerable regional differences of the geological factors.

In the analysis, at first, we used 87 landslides occurred by the Mid-Niigata earthquake within pre-existing landslide topographies and randomly selected 87 pre-existing landslide topographies which did not moved by the earthquake. After logistic regression analysis, we selected the most influencing factors and calculated the coefficients. We used logistic regression method of multivariate analyzing software of SPSS Statistics Ver.19 (SPSS Inc.). After using stepwise method to select the topographical factors, surface roughness and marginal erosion ratio are acting as most influencing factors for landslide occurring. After validation, the result showed that 74.7% of landslides correctly predicted in the Mid-Niigata earthquake. Using by the coefficient from analyzing result of the Mid-Niigata earthquake data, we predicted the landslides by the Iwate-Miyagi Inland earthquake, and the accuracy is 77.2%. Based on this result, surface roughness and marginal erosion condition are considered to strongly influence the occurrence of landslide by earthquake. Therefore, we re-analyzed the data from both the Mid-Niigata earthquake and Iwate-Miyagi Inland earthquake; used 116 landslides occurred pre-existing landslide topographies and randomly selected same number of non-occurred pre-existing landslide topographies. The validating result showed, the predicting accuracy is 75.4%.

The result of above analysis suggested the, logistic regression method is useful method to evaluate earthquake-induced landslide. Using this method, we will conduct earthquake-induced landslide susceptibility mapping around active fault.

Keywords: earthquake, landslide, multivariate analysis, susceptibility evaluation, Mid-Niigata earthquake, Iwate-Miyagi Inland earthquaek

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Study of relationship between earthquake-induced landslide displacement with groundwater condition based on landslide me

Akira Nakamura[1*], Bateer Hasi[1], Maruyama Kiyoteru[1], Noro Tomoyuki[1]

[1]PWRI

As a triggering factor of landslides, strong earthquakes were known to induce large-scale landslides in mountainous region. Due to less measurement data that captured landslide movement at earthquake, the characteristics of landslide behavior are still not clearly understood. So far, there are few reports that collected and documented the displacement of landslide measurement at earthquakes. In this study, we collected literatures that include description about landslide measurement at earthquakes occurred from 1964 to 2007 in inland and offshore of Japanese islands.

We analyzed these data from literatures, revealed some characteristics of landslide sites, including landslide movement, groundwater level and pore water pressure change of at earthquake.

1)Landslides sites where no movement before earthquake, tends to result relatively large displacement, but rarely continues its movement during and after that earthquake.
2)Landslides that acting by rainfall before earthquake, show more displacement during earthquake than before earthquake; but after earthquake, it will become steady in some cases.
3)The depth of displacement of landslides is the depth of slip surface in most of the cases.
4)In most of the cases, the groundwater level or pore water pressure of landslide site increased at earthquake.
5) After earthquake, groundwater level and pore water pressure in landslide site recovered to the level before that earthquake, the period ranged 1 day to 3 months.

According to the above characteristics of landslide displacement at earthquakes, it is considered that the abrupt rise of groundwater level or pore water pressure is a possible factor that initiate landslide movement during earthquakes.

Keywords: Earthquake, Landslide, Landslide measurement, Landslide displacement, Groundwater level

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Self potential measurement at landslide site in Pelabuhan Ratu, Indonesia

Shuhei Yabe[1*], Hiroshi Otsubo[1], Shimpei Kon[1], Febty Febriani[1], Peng Han[1], Katsumi Hattori[1], Edy Gaffer[2], Adrin Tohari[2], Kohri Sugianti[2], Boko Nurdiyanto[3], Iwan Maulana[3], Noor Effendi[3], Suhardjono[3], Pri Harjadi[3]

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Recently, rainfall-induced landslides occur frequently. In order to mitigate landslide disasters, understanding of the landslide process and early warning is important. In this study, self-potential 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.

In July 2009, in order to assess the adequacy of the place as a field site, the electrical resistivity tomography has been performed to estimate the subsurface structure, identify saturation zone, and sliding surface. The result shows that saturation zone and possible sliding surface exist at a depth of 10-20m and 20-25m, respectively.

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 and a rain-gauge have been installed. Additionally, 3 boreholes have been drilled to verify electrical resistivity tomography results. Two of them is used for clinometer measurements every month to identify slip layers and one of them is for measure of water table. During the installation, impermeable layer around 4 m deep have been also found. This is also a possible slip surface. The continuous data are available after December, 2010 and now the data are going to analyze. The details will be presented in our presentation.

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A sandbox experiment for hydrology and electromagnetics coupling

Hiroshi Otsubo[1*], Shuhei Yabe[1], Shimpei Kon[1], Febty Febriani[1], Peng Han[1], Katsumi Hattori[1], Edy Gaffer[2], Adrin Tohari[2], Khori Sugianti[2], Boko Nurdiyanto[3], Iwan Setiawan[3], Noor Effendi[3], Suhardjono[3], Pri Harjadi[3]

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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 study, basic study on early warning system for landslides will be investigated to understand landslide process through hydrological and electromagnetic changes. The final goal of the study is to develop a simple methodology for landslide monitoring/forecasting using self potential method. Conventional methods to monitor landslides are based on geotechnical and hydrological approaches to measure pore pressures and displacement on the surface. In these methods, boreholes are required in general and may disturb the subsurface water system. Making boreholes causes a higher cost for monitoring and it is not so practical for field applications. On the other hand, self potential measurement to measure the surface potential difference using two electrodes is easy to set up and measure continuously.

In this study, the sandbox experiment has been conducted. For the sandbox system, it is possible to control the water table under the soil and it provides us the relationship between hydrological and electromagnetic changes in quantity. We examine various water levels and hydraulic gradients for the investigation. The results show the self potential value seems to be control by the electro-kinetic effect and the water table.

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An attempt to construct hazard maps based on slope structures in the Koizu Coast, Shimane Peninsula

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Although slope hazard maps have been made all over the world, most of them are not sufficient and not effective for use. Then, the author attempted to construct effective slope hazard maps based on the slope structures and types of slope movements in the Koizu coast, where bedding plane dips almost same trend with that of the slope.

Results of filed survey show that slope failures tend to occur along such bedding planes of alternating beds of sandstone and mudstone there. Although the rock slope has roughly 'slipping structure', dip angle of the slope is gentler than that of bedding plane in most portions, and therefore they are relative stable. However, dip angle is steeper that of bedding planes along outer rim of cave portions due to gully erosion or wave erosion. Probably, unstable condition propagates from such portions to whole slopes.

Based on the mechanism mentioned above, that is slope failure occur along bedding planes, it may possible to evaluate the degree of the instability in each points by analyzing geometrical relationship between slope shape and bedding plane. Analyses were made by using Hoek and Bray method and geological and topographic data, which were obtained from strike map of bedding planes and 5m mesh DEM.

The slope hazard map constructed here shows that unstable regions tend to appear along the portions influenced by gully erosions or wave erosions, and the unstable zone will expand along whole slopes from such portions in this area.

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Origin and age of LiDAR-detected scarplets on the mountain slope: a case study around Iyano in Neo valley, central Japan

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Recent airborne LiDAR survey has detected many scarplets in the mountains around the northern tip of the active Neodani fault, central Japan, which is one of the faults that were ruptured during the 1891 Nobi earthquake. To examine origin and formation age of some of these small scarps, we conducted LiDAR-data analysis, geomorphologic and geologic mapping, and pit excavation around Iyano in Nogo valley. Our results show that the scarps around Iyano are sagging features associated with gravitational mountain deformation, and can be explained by a model in which toppling and block rotation of reverse-dip slope associated with gravitational subsidence of mountain top creates parallel uphill-facing scarps. In addition, our pit excavation in a linear depression along one of the scarps reveals that the scarp was formed before 15th century. Furthermore, the scarp is likely to have grown at least once after its formation. Further study of similar scarplets elsewhere may clarify the relationship between formation and growth of those scarps and surface-faulting history of the Nobi active fault system, including the Neodani fault.

Keywords: Neodani fault, mountain slope, airborne LiDAR, scarplets, Nobi Earthquake, sagging

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Landslide inventory mapping in the Lower Nepal Himalayas and its implication for landslide susceptibility mapping

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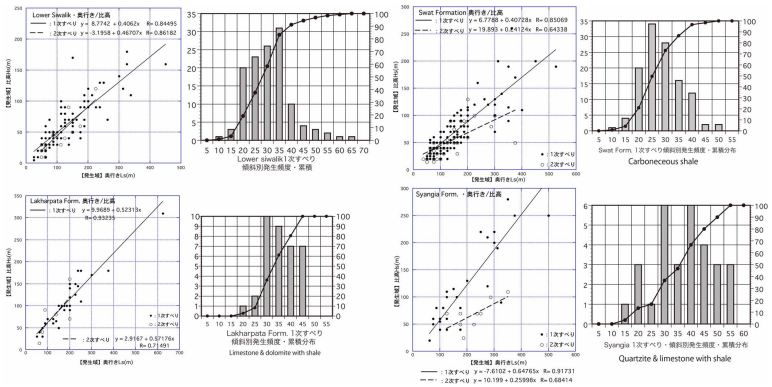
[1]Yamagata University, [2]Geospatial Information Authority, Japan

Inventory mapping of landslides in the central western parts of Lower Himalayas in Nepal was implemented, using aerial photographs in scale of 1/50000. A study area covers from longitude 83 east to 84.025 degere east and form latitude 27.5 degree north to 28.375 degree north. This area also covers Siwalik Hills, Mahabharat Ranges and Lower Himalayas where active faults are distributed and of which altitude is ranging 100 to 2800m asl. The active faults such as MCT and MBT continue along the base of the foothill of Nepal and Indian Himalayas. The inventory map is superimposed with topographic map generated from GDEM, geological map in scale of 1/200,000 issued from Geological Survey of Nepal and active fault map located on topological maps in scale of 1/50,000. Author measures geomorphological characteristics of landslides of which total number is 512 in and Tansen area, such as width, relative heights and gradients of source area of landslides for each geological type, to clarify the gomorphological and geological conditions that are prone to cause landslides.

Mean slope gradient of landslide source area is different by each geological type. And the critical gradient at which the number of landslide abruptly increases varies by each geological type (Fig.1). It means that lithological property of each rock affects the degree of vulnerability for landslide. Gradients of the secondary landslides decrease compared with those of the primary ones, due to advanced fracture of rock masses. The most hazardous rocks in this region are Lower Siwalik Formation of unconsolidated mudstone or Swat Formation of carbonaceous shale that easily slide at lowest angle. Those slope angles of source areas are less than 20 degree. However, limestone or dolomite of which critical slope angle is as high as ca 30 degree, indicate high rigidity and resistance for landslide.

Earthquakes that occur along those active faults will affect stability of Himalayan mountain slopes. Authors try to prepare the susceptibility map on earthquake-induced landslides, nsidering those causative factors of landslides.



Keywords: landslide inventory map, Lowe Nepal Himalaya, geomorphologic feature of landslide, critical slope gradient, landslide susceptibility map, active fault

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Relationship between rock weathering and geological structures in the Dumre Besei landslide, Lesser Himalaya Nepal

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Dumre Besi landslide is one of the most active landslides along Mugling Narayanghat road section of Nepal Himalaya that was initiated during the monsoon of 2003. The external trigger of this landslide is heavy rainfall, however geological structures and rock weathering have played the key role in the formation of this landslide. The main lithology of the landslide zone is thinly laminated light grey siltstone, grey sandstone (quartzite), bluish grey to white phyllite, black carbonaceous shell, and dolomite. A thrust fault passes through the center of the landslide, which has created a thick deposit of loose and weathered rock material and has developed very thick shattered zone, where weathering is very intense. The rocks in the landslide zone are divided into 5 zones according to the severity of weathering as none, slight, moderate, severe and complete based on field and laboratory analysis.

Laboratory analysis suggested that the chemically weathered rocks are significantly rich in clay minerals. Formation mechanism of clay minerals was analyzed by various techniques as XRD, XRF and thin section analysis and it was found that most of the clay minerals are formed by weathering of rocks. The main clay minerals thus formed are chlorite, semectite and vermiculite. These clay minerals reduce the rock strength and also semectite has a swelling property when water is added into it. The weathering and thrusting has created a thick zone of loose material that is rich in clay minerals, which flows as the debris in every monsoon season. Also, the slope angle, topography, rainfall and ground water are responsible for the formation of this landslide.

Keywords: Landslide, Himalaya

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Features of Slope Disasters on Roads by the Heavy Rainfall in Chugoku and Northern Kyushu Area in July 2009

Ken-ichi Asai[1*], Hiroyuki Hayashi[2], Yasuhito Sasaki[3]

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We collected 90 cases of the slope disasters on national and prefectural roads by the Heavy Rainfall in Chugoku and Northern Kyushu Area in July 2009, and examined the characteristics of these slope disasters.

More than 50% of disasters are surface collapse at cut slope, about 20% are the collapse of the embankment and road shoulder. On the other hand, the natural slope surface failure is about 15% less. And most of debris flows occurred locally around Hofu city.

The geology of the disaster area is mainly consisted of granites, schist, and Tertiary sedimentary rocks, and both of these are remarkably weathered. Many cases of the collapse occurred in "non-Valley" slope such as the cut slope on the ridge, and the relatively few cases occurred in the valley. Some cases of the collapse of embankment and road shoulder is influenced by the concentration of the water flowing on the road.

Slope disasters occurred not only in the heavy rainfall area, but only in a few rainfall area. Many disasters are caused by weathering over time of cut slope, surface water on the road, watershed change by land development around the road, and cut in small valley by the new or widening road. These causes are not focused on previous patrols and inspections. And also there are many cases that a small valley remains still above the cut slope and no countermeasures against soil flow.

These disasters reveal the problem that the present countermeasures have been mainly protecting slopes but have not been specifically cut off sources of surface water. Disaster risk and road maintainance costs can reduce in the future, implementing measures against surface water, for example, to disperse surface water.

Keywords: slope, disaster, heavy rainfall

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Features of Slope Disasters on Roads by the Heavy Rainfall in Amami Area in October 2010

Hiroyuki Hayashi[1*], Ken-ichi Asai[1], Yasuhito Sasaki[1]

[1]Public Works Reseach Institute

We collected about 60 cases of slope disasters of roads in Amami area 2010, and examined the features of disasters.

About 80% of road slope disasters have occurred in cut slope,about 60% are surface slope collapse, and 20% are the large-scale collapse from the natural slope above cut slope. The number of disasters is less than that in usual rainfall disaster, but the size of each disaster tends to slightly larger.

Basement rock in this area is mainly consisted of shale and sandstone of the Shimanto Belt. Many places of the slope disasters have deeply weathered and become red soils. Cut slope collapse is in the shallow surface, but the collapse at the ridge cut occurred deep.

There are only few cases of debris flow. Collapse of the embankment and road shoulder is about 10 percent. The main cause of the collapse of shoulder is concentration of the large amount of water flowing on the road surface.

Keywords: slope, disaster, heavy-rainfall

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Study on the feature of the landslide using GPS monitoring and LiDAR DEM

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The landslide disaster occurred at Shimekake district in Yamagata Prefecture on the snow melting period in 2009. We studied on the form feature and the movement style of the landslide from distribution of the ground surface cracks, the continuous GPS observation, and the comparison analysis using LiDAR DEM of two times.

This landslide is located in the northwest of Gassan-Volcano. The green tuff, sedimentary rocks, and the dolerite of Neogene are underlying in the surrounding area.

The cracks on the crown of landslide were found in the residential area on February 25. Afterwards, the movement continued until the beginning of July, and many cracks were formed to enclose the landslide area. Afterwards, the movement has decreased since July 8.

The subsidence zone was caused on the head of landslide in the direction of E-W. On the western side of the movement area, cracks were caused in parallel in the direction of the southwest. On the eastern side, cracks with bump were formed in parallel. In the part of southwest, the rice field upheaved and tilted due to strike-slip cracks with bump.

Only the GPS observation followed to the rapid and large movement. The maximum of the amount of the accumulation displacement reaches 4.2-6.2m (15cm /day) in the beginning of July. Main body of this landslide moved toward south, and on the toe of landslide, moving direction changed to eastward.

The displacement vector was analyzed with the method of Digital Geomorphic Image Matching Analysis. The center part of the movement block moved toward south about 5m for five years. The place of changing displacement value is corresponding to the part where cracks were remarkable on the ground surface.

This landslide is rock glide type that platy body slide down on the plane. The landslide movement was strongly controlled with geological structure of Neogene strata. Landslides with large movement like this landslide are well observed with GPS and LiDER.

Keywords: GPS, LiDAR, landslide, disaster, snow melt period

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Experimental Study on the Damaging Mechanism of Cable by Submarine Landslides

Tomokazu Sonoyama[1*], Fawu Wang[1], Mitsuki Honda[1]

[1]Shimane University

1.Introduction

Submarine communication cables are frequently broken by submarine landslides and turbidity currents. When the cable was cut, the economic loss is vast for cable restoration and the stop of information transmission. However, there are considerable points are not clear because the submarine cable breaking occurred under the surface of water. For the prevention and mitigation of the sea area disaster around Japan, the study of submarine landslides is necessary.

The aim of this study is to quantitatively evaluate and analyze the impact forces against the submarine cable. From the viewpoint of lifeline disaster prevention, the estimate of impact forces to cable by submarine landslides is very important to contribute to the marine development and use in the future.

2. An experiment method and condition

An experimental apparatus to study submarine landslide was developed and used in this study. This apparatus is a cylindrical water tank of 1.9m in height, 1.8m in diameter, and 0.4m in width. Cylinder bottom has shear stress sensor, pore water pressure sensor, and normal stress sensor. By putting the mixture of water and soil into this apparatus, and making it rotate, it is going to reproduce the submarine landslide. It can be rotated at the speed from 0.013m/s to 0.78m/s.

In addition, the impact forces to the cable are able to be measured by setting up the cable model that puts the strain gauge in the apparatus while the submarine landslide is moving. The cable model is a pipe made of the vinyl chloride of 22mm in the diameter. As for the real submarine cable in the spot, the transformation to the cable extension direction is not forgiven so that it is considered to be the infinite length. Therefore, both ends of the cable model are fixed perfectly in the submarine landslide apparatus.

Experiments were carried out to clarify the three influences: (1) Influence by the velocity of submarine landslide; (2) Influence by the volume of submarine landslide; (3) Influence by the setting height of the cable.

Silica sand No.7 was used for those experiments. This silica sand has following features. Soil particle density = 2.63g/cm^3, Maximum density = 1.566g/cm^3, Minimum density = 1.026g/cm^3, Maximum void ratio = 1.563, Minimum void ratio = 0.679, D_{50} = 0.1mm, D_{30} = 0.079mm, D_{10} = 0.056mm, uniformity coefficient = 1.82, coefficient of curvature = 1.09.

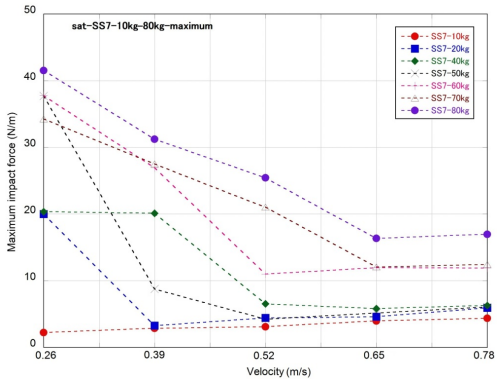
3. Consequence and consideration of experiments

First, experiments that 10kg˜80kg of saturated silica sand No.7 rotated by 0.26m/s˜0.78m/s were conducted.

The figure shows the relation between maximum impact forces (N/m) and landslide velocity (m/s). As a result of those experiments, the impact forces to the cable model became greater when landslide velocity became slower. The impact forces decreased to a critical velocity and then increased with landslide velocity. In addition, the critical velocity became faster when the volume of landslide became larger. Here are some reasons to consider: (1) Non-turbid Soil mass movement strike against the cable model; (2) As landslide velocity became fast, soil mass movement was became current of low density. In other words, soil mass movement shows aspect of submarine landslide when slow velocity. However, soil mass movement shows aspect of turbidity current when fast velocity.

The impact forces to the cable model became larger with the increase of the volume of the landslide, and the impacting time became longer.

However, clear tendency wasn’t found from the difference of the setting height of the cable model. More experiments by various setting height of cable is necessary in future work.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SS7-10kg
SS7-20kg
SS7-40kg
SS7-50kg
SS7-60kg
SS7-70kg
SS7-80kg
Maximum impact force (N/m)
Velocity (m/s)
0
10
20
30
40
50
0.26
0.39
0.52
0.65
0.78

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Characteristics of landslide hazard related to knick line distribution and premonitory phenomena of landslide occurrence

Shinjuro Komata[1*]

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Characteristics of landslide hazard related to knick line distribution and premonitory phenomena of landslide occurrence

Shinjuro KOMATA
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Japanese archipelago situates in plates conjunction of subduction zone, which has many earthquakes and volcanic activities. Mountains also continue to upheaval under the stress space in tectonically active during quaternary. Moreover under the humid condition, rivers erode slopes currently to occur strains and micro failures in slope rock mass and form eroded geomorphology such as knick lines. Slope rock mass become fragile under long term weathering. These geologic, geomorphologic and humid conditions of Japan affect to erosion in low mountainous area in middle basin, and occurrences of mass movement such as landslide and failure.

This paper describes phenomena based on practices, such as the erosion process related to the increased flow after river capture of neighbor basin, the occurrence of rock slope deformation prior to the occurrence of landslides, and the mechanisms of landslides.

Keywords: Knick line, River capture, Mass movement, Loosen rock slope, Landslide

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

HDS027-P16 Room:Convention Hall Time:May 24 16:15-18:45

Pyroclastic flows and lahars at the time of the 2010 eruption of Mount Merapi, Indonesia

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On October 26, 2010, Mount Merapi has resumed eruptive activities after the 4-year dormancy. Pyroclastic flows ran down to the western and southern direction. Especially, pyroclastic flows having occurred in the beginning of November, 2010 were very large and have reached up to 15 km from the summit of the volcano. On the other hand, lahars have also occurred in almost all the rivers in the western and southern directions instead of Gendol River where the extra large pyroclastic flows have occurred. The huge amount of pyroclastic flow deposits remained unsaturated and hot even after one-month has passed since the deposition of the pyroclastic flows. Field measurement shows that some hot-spots which is hotter than 100 degree in Celcius still existed on the deposit. The lahar generation in the Gendol river must occur in near future, but the timing may be later than in other rivers.

Keywords: Mount Merapi, Pyroclastic flow, Lahar

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Temporal variations in erosion rate, moisture and water contents near slope surface in a badland in southwestern Taiwan

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We have measured erosion rate and investigated the weathering mechanism of Pliocene-Pleistocene mudstone in the badland of southwest Taiwan. Erosion rate was measured by using erosion pins set on slopes with an average inclination of 45-55 degrees. We found that significant erosion occurred only in wet season from May to September and that the rates were as large as 10 cm/y on average. Such a high rate of erosion is due to the characteristic manner of the weathering of the mudstone, of which uniaxial compressive strength is as high as 10 MPa when dry but becomes a few Mpa when it is wet (Lee, 2007). Physical property measurements and needle-penetration tests performed for the samples drilled from slope surfaces indicated that weathering extended as deep as 10 to 20 cm from a slope surface. The surface layer of mudstone changes its moisture content and hardness according to the precipitation condition. X-ray CT images for the drilled cores show that the density of mudstone has decreased in the surface layer. In-situ monitoring of moisture content and electric resistivity in the slope suggested that salt and water migration occurs in a periodic manner with one or two year cycle in the surface layer of a slope. Salt materials migrate from the depths and are concentrated in the surface part of a slope in dry season and beginning of wet season and are then diluted in wet season. This dilution of interstitial water is assumed to be accompanied by chemical osmosis and following expansion of rocks, of which process may be the essential mechanism of the rapid weathering and erosion of the mudstone in the badland of Taiwan.

Keywords: badland, Pliocene-Pleistocene mudstone, rapid erosion, salinity-moisture variation, monitoring

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Field observation of sediment supply processes in a large landslide using laser profilers

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Large-scale landslides continuously supply sediment into rivers after their initial formation by increasing in their size and the denudation of exposed bed rock. We quantitatively examined characteristics of sediment supply processes in the Aka-Kuzure, a large landslide in central Japan, based on the laser-scanning data in 2003, 2007 (Airborn LiDAR) and 2010 (Terrestrial Laser Scanning). By comparing topographic data in three periods, three types of sediment supply processes were found in Aka-Kuzure: deeper landslides ($>$ 10 m in depth), linear erosion (erosion rate of about 1 m yr^{-1}), and sheet erosion (erosion rate of about 0.2 m yr^{-1}). Deeper landslides were found above knick lines, whereas linear erosion occurred around steep slopes in the stepped terrains parallel to the bedding planes. These results indicate that the type of sediment supply process in the Aka-Kuzure is affected by local topography and geology.

Keywords: large landslide, Aka-Kuzure, laser profiler, sediment supply