Long-term hydrogeomorphological changes inferred from lacustrine sediment information

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The Lake Biwa sedimentary records (200-m core and 1400-m core) cover the last 4 Myr, but detailed information is limited in the upper part of the sediment (250 m; ca. 450 ka). The information of the Lake Baikal sedimentary records used here for comparison is limited during the past 780 kyr although the records obtained until now cover the last 10 Myr. It is already reported that long and short Milankovitch cycles are printed in the lacustrine records of the two lake-catchment systems. Lacustrine information should be interpreted through geo-environmental settings. In this presentation Lake Baikal and Lake Biwa sedimentary information will be discussed in the viewpoint of long-term hydro-geomorphological fluctuation with geo-environmental settings. The sedimentary items used for discussion are grain size (sediment and mineral), organic content, bi-SiO_2 content, HCl-soluble content, and mineral content of both lacustrine sediments for the past 450 kyr and 780 kyr, respectively. Common and different trends for the both systems will be discussed.

Keywords: long-term hydrogeomorphological changes, lacustrine sediments, lake-catchment system

Effects of permeability on the development of experimental landform

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Uplift rate and rainfall intensity are the main factors controlling the development of experimental erosion landform. However, characteristics of sand mound to be eroded (mainly permeability) are also an important factor determining the way of experimental landform development. This time I would like to discuss the development of experimental landform with uplift and rainfall erosion from the view point of effects of permeability of sand mound, especially based on the results of runs with the same uplift rate (0.36mm/h), runs 26, 27, 32 and 38.

run-------permeability----------precipitation---------width of deposition area
26--------2.57x10^{-4}cm/s---------40-50mm/h----------100mm
27--------3.23x10^{-4}cm/s---------80-90mm/h----------100mm
32--------1.84x10^{-4}cm/s---------80-90mm/h----------200mm
38--------1.53x10^{-3}cm/s---------80-90mm/h----------200mm

When a square sand mound is uplifted from a flat surface under the mist type artificial rainfall, fluvial erosion starts from the edge of uplifted area and this erosion soon develop into valley systems. The advance of valley erosion as the mound elevation increases by uplift results in the development of slopes, and slope failures occur frequently. Stream channels become relatively stable and become paths of transport for the material yielded by slope failures. Sediments are discharged from the system effectively by this fluvial process. Large slope failures or landslides tend to occur concentratedly with a certain cycle, and the average mound height change around a certain height, decreases in the periods of landslide concentration and increases with uplift between these periods. This height seems to be determined by the rate of uplift except in the case of extremely high uplift rate.
Permeability and strength of sand mound is considered to be determined by the degree of compaction as far as the same material (a mixture of fine sand and kaolinite 10:1 by weight) is used. While density, which is considered to represent the degree of compaction, have a clear negative relation topermeability, shear strength of saturated material does not show clear relation to density. The degree of compaction apparently controls permeability but not shear strength at least in this series of experiments. Runs 26 and 27, the deposition area of which is 100 mm wide, are different in rainfall intensity, while runs 32 and 38, both of which have 200 mm wide deposition area, different in permeability. However, difference in the development of experimental landform within each pair of runs shows a certain similarity. Relatively low and flat surface with sporadic steep small hills developed in runs 27 and 32, while relatively high and massive mountains appeared in runs 26 and 38. Rainfall intensity is lower in run 26 than in run 27, and permeability is higher in run 38 than in run 32. Assuming that permeability controls the amount of surface runoff, high permeability in run 38 can be considered to have effects similar to the low rainfall intensity in run 26. The estimated amounts of surface runoff, calculated by subtracting the value of permeability (cm/s) from precipitation (mm/h), are 8.4-11.4x10^{-4}, 6.4-9.7x10^{-4} cm/s in runs 26, 38, and 2.0-2.3x10^{-3}, 1.9-2.3x10^{-3} cm/s in runs 27, 32, respectively. Runs 26 and 28 have the amount of surface runoff a digit larger than runs 27 and 32. Large amount of surface runoff promotes faster valley erosion longitudinally and laterally, and the development of low and flat surface in runs 27 and 32. In runs 26 and 38, on the other hand, valley erosion was not so active as in runs 27 and 32, and high and massive mountains formed with frequent landslides as a result. Effects of shear strength are uncertain this time; however,

observation on the series of experiments including other runs revealed that the strength of sand mound has some effects on the way of slope failure.

Keywords: development of experimental erosion landform, uplift, permeability, shear strength, surface runoff, slope failure

Distibution of Sans Dunes with a Cellular Model

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Sand dunes are found in many places such as deserts, the sea bottom and the surface of Mars.Most fascinated dune is barchan, which is crescent dune. We reproduced many barchans in numerical simulations and investigate the dynamics. The motion of sand grains is realized by two processes: saltation and avalanche. Saltation is the transportation process of sand grains by flow. We reproduced a lot of barchans in numerical field by above model. Barchan releases sand from tips of two horns. The downwind barchan can capture the sand stream. Also, barchans sometimes collide each other. These direct and indirect interaction forms complex barchan fields. The size distribution of a few thousand of barchans is fitted by lognormal distribution well. This indicated that the small barchans exist around the large ones and the large barchans are around small barchans. The average size of barchans increase as the amount of supplied sand do.

Keywords: sand dune, size distribution

Relationships between rainfall, water level fluctuation and landform change of riverbed since 2011 in Kamikochi region, the upper Azusa River, central Japan

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The purpose of this study is to discuss relationships between rainfall, water level fluctuation and landform change of riverbed in Kamikochi region, the upper Azusa River, central Japan. Based on ground surveying geomorphological maps of the observation area were made every year in summer season. Interval shooting cameras took photographs every 15 or 20 minutes interval. Rainfall data were obtained from AMeDAS Kamikochi station. Also section surveying performed every autumn season. The analyses of this study were performed using the data since 3 July 2011 when the cameras were set.
The rainfall event whose daily rain fall over 100 mm in the Baiu rainy season caused the bankfull discharge and the major landform change, which was channel migration. When the channel migration occurred, without gradual lateral move of channels, former channels were buried and/or narrowed with new main channels excavation. During the Baiu rainy season about 80mm of daily rainfall caused small landform changes, for example slight lateral erosion by channel move. Any landform changes were not occurred during under 50mm/day rainfall event in the Baiu rainy season and even about 100mm/day rainfall event after the Baie rainy season.

Keywords: fluvial geomorphology, landform change, lateral erosion, rainfall, watar level fluctuation, Kamikochi

The estimation of a rainfall index triggering landslides based on hydrological observations at Mt. Mihara, Izu-oshima Island, Japan.

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Typhoon Wipha brought many shallow landslides in Izu-oshima Island on 16 October, 2013. We investigated the physical properties of slope materials and the subsurface-water responses for rainstorms at a shallow landslide site. Alternation of tephra and loess layers within 2.5 m depth overlays the basaltic spatter and lava around the investigated site. Slip surface of the shallow landslide was formed in a tephra layer (the so-called Y1.0). The Y1.0 tephra layer mostly composed of sand had a hydraulic conductivity of approximately 10^{-3} cm/s with the high gravitational drainage capacity (5-10%). The loess layer within ~115 cm depth mostly composed of silt and clay had a hydraulic conductivity of 10^{-5} cm/s and high water retention capacity (50-55% within the field capacity). During a rainfall event with total rainfall more than 97 mm, the positive pressure head was observed both in the loess layer and in the bottom of Y1.0 tephra layer above the loess layer.Statistical analysis based on the records of 14 rainfall events from 2014 to 2016 showed a liner relationship between maximum pressure heads and an antecedent precipitation index (half-life of 4 hours). Based on statistical analysis of the past severe rainstorms, the slope would become unstable with the antecedent precipitation index (half-life of 4 hours) more than 217-253 mm. During typhoon 26th event in 2013, the maximum pressure head at the bottom of the Y1.0 tephra layer could have reached at +5.4 kPa. This high pore-water pressure in the Y1.0 tephra layer must be a cause of the shallow landslide in 2013.

Keywords: tephra, loess, alternation, hydraulic conductivity, subsurface storm flow, antecedent precipitation index

Vertical changes of soil properties and infiltration process for occurrence of shallow landslides in hillslopes with different bedrocks

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We examined the vertical change of physical, mechanical, and hydrological properties of soil-slip scars which is formed by rainfall-induced shallow landslides in hillslopes with granite and hornfels. On Granitic hillslopes, there are highly-permeable sand with a large shear resistance angle and a small cohesive strength. Hornfels hillslopes has are covered by sticky and low permeable soil with a small shear resistance angle and a large cohesive strength. Percolation rate from tensiometric data in unsaturated zone of the granite hillslope are higher than that of the hornfels hillslope. Slope stability analysis suggests that many landslides occurred in granite hillslopes does not require a rise of subsurface pore water pressure although in hillslopes of hornfels occurrence of shallow landslides needs a subsurface pore water pressure, respectively. These results suggest that factors for landslide occurrence are different in each hillslope.

Keywords: Granite, Hornfels, Shallow landslides, 2014 Hiroshima landslide Disaster

Effect of shallow landslides on migration of channel heads: Case studies in Hiroshima City and Hofu City, western Japan

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The temporal variation in channel-head location due to heavy rainfall was examined with topographic analysis using 1-m grid DEMs and field survey in granitic mountains in Hiroshima City and Hofu City where debris-flow disaster occurred during a recent decade. For both cases, the total number of channel heads increased after the heavy rainfall events, and post-event (new) channel heads formed by the heavy rainfall were located upslope from pre-event channel heads. Although pre-event channel heads had no significant correlations between source area and local slope for both areas, post-event channel heads with shallow landslides induced by the heavy rainfall had strong inverse correlations between them. Subsurface flow controlled by topographic convergence would cause the strong inverse correlations for both sites. Most pre-event channel heads were located close to springs fed by groundwater flow, and old landslide scars were confirmed headward slope of the springs. Downstream channels of the springs would be maintained by erosion of stream flow, although old channels would be buried by debris.

Keywords: hillslope, head hollow, micro-landforms, spring

