Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

HGM02-P01 Room:Convention Hall Time:May 26 18:15-19:30

Measurement of changes in wall surface morphology in Yoshimi-Hyakuana cave by terrestrial laser scanning

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Detection and quantitative evaluation of changes in surface morphology of rocks are crucial issue for the understanding of processes of weathering. Using terrestrial laser scanning (TLS) approach, detailed topographic measurements of wall surface morphology were performed repeatedly at a test site of Yoshimi-Hyakuana cave in Saitama Prefecture, central Japan. Time series of point clouds and digital elevation models (DEMs) were compared to each other, revealing the locations of centimeter-scale changes in the wall surface, likely induced by salt weathering. The spatial distribution of such surficial changes will be further assessed by continuous measurements, with appropriate accuracy assessments.

Keywords: TLS, weathering, point cloud, digital elevation model

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Arsenic contained in the pore water of the natural sediments in the northern part of the Nakagawa Lowland, Japan

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The Kanto Plain is the largest lowland in Japan. Marine sediments are found over a wide area here, even more than 50 km inland from the present shoreline, because of the global cyclic changes in sea levels. The dependence on groundwater to meet the water needs in this area is relatively high. In particular, groundwater is the source of approximately 40 % of the municipal water supplies. Arsenic levels, greater than those permitted by the environmental standards of Japan, have been detected in the groundwater of this area. Therefore, measurements were conducted to evaluate the occurrence of arsenic and other related elements in the pore water contained in the natural sediment layers. We measured the levels of various inorganic chemical substances, such as arsenic (As), iron (Fe), and sulfur (S), and major dissolved ions, such as sulfate (SO_4^{2-}), calcium (Ca^{2+}), and sodium (Na^+). The pore water was collected from sediment samples, obtained by drilling from the river bottom down to a depth of 44 m. The pore water samples were obtained immediately after the extraction of the sediments. The sedimentary facies shown in the vertical profile are continental, transitional, and marine, including two aquifers. The upper aquifer (15~20 m) contains fine to coarse sand, whereas the lower aquifer (37~44 m) contains fine to coarse sand and gravel. The concentration of arsenic and other inorganic elements was measured by an inductively coupled plasma mass spectrometer (ICP/MS) and an inductively coupled plasma atomic emission spectrometer (ICP/AES). The concentration of major dissolved ions was measured by an ion chromatograph analyzer. The total chemical element content was measured by X-ray fluorescence analysis, using solid sediment samples. We obtained the following results. The arsenic concentrations in the pore water of the marine silt and clay sediments (approximately 40 mg/L) were about five times higher than those in the continental sediments (approximately 8 mg/L). The highest concentration of arsenic (74 mg/L) was detected at a depth of 13 m, which is immediately above the upper aquifer. Visual observations confirmed oxidizing conditions for this level. Therefore, it points to arsenic being adsorbed to iron hydroxide in the sediments. In contrast, in the top part of the section, from the river bottom to a depth of approximately 3 m, the arsenic concentrations in the pore water were clearly high, and decreased gradually and continuously with depth. This is ascribed to the anthropogenic impact on the river.

Keywords: Heavy metal, Arsenic, Water-rock interaction, Pore water, Leaching, Pollution

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A recursion model for calculating the original widths of narrow terraces and their lateral erosion rates on rock coasts.

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This presentation presents a new and simple recursion model for calculating the erosion rates of flights of narrow terraces under conditions of regular uplift. The general equations developed are: Δxn = Δx'n + Δxn-1 - Δzn-1/tanθ, and εn = Δxn/tn - tn+1, where n is the number of narrow terraces, Δxn is the original width of narrow terrace n, Δx'n is the observed width of narrow terrace n, Δxn-1 is the original width of narrow terrace n-1 (one step below terrace n), Δz is the height of the narrow terrace, θ is the gradient of the slope, ε is the lateral erosion rate, and t is the time uplifted. The model can be used to calculate the lateral erosion rate if the widths of the present shore platform and of the emerged narrow terraces can be obtained, and where chronological control is available. Lateral erosion rates on the Ashizuri, Boso, and Kii peninsulas in Japan, as well as the Huon Peninsula in Papua New Guinea, were calculated using the model to be approximately 0.001, 0.2-1.0, 0.009, and 0.002-0.014 m/yr, respectively. These calculated values are in agreement with the rates of lateral erosion determined in previous studies.

Keywords: rock coast, recursion model, lateral erosion rate

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Adjustment processes of river longitudinal profile: laboratory experiment

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It is generally recognized that longitudinal profiles of graded rivers take exponential curve shapes. Even in an uplift area, a river attains a stable state, i.e., dynamic equilibrium between uplift and fluvial erosion. The change or adjustment of a river profile, however, is not still understood well, especially for a bedrock river. We have conducted physical model experiments in which an initial slope of the mixture of sand and silt was set up and rivers developed by incision of the slope. A weir with a slit at the center was placed at the downstream end to prevent the base-level change due to uncontrolled sedimentation inside of the observed area. Constant rainfall was realized by very fine mist supplied from ten nozzles installed above the flume. The rate of tilting, the axis of which was sited at the shoreline (landward uplift), can be controlled. The parameters of the present study are the gradient of an initial flat slope and the uplift rate. Two types of experiment were conducted, Ex. (i): experiments to test the dependence on initial slope gradient with no uplift; Ex. (ii) to examine the effect of tilting uplift. Results are as follows: Ex. (i) showed that the trunk stream eroded the river bed through two stages. The first stage ended when the valley head erosion ceased. The second deepening started because of the development of tributaries and resultant increase of stream discharge. At the same time, knickpoints generated, which were caused by strong erosion near a junction owing to the difference of bed gradients between a trunk stream and its tributary. Ex. (ii) showed that rivers were more influenced by tilting than erosion at first, but erosion gradually increased to balance with uplift (dynamic equilibrium). The experiment in which the tilting rete was changed during the run also showed dynamic equilibrium topographies for each tilting rate, but a profile with a part of convex shape occurred during the transition. The present study suggests that knickpoints occurs during the process to toward a graded state, equilibrium state for both static and dynamic equilibrium states.

Keywords: river longitudinal profile, laboratory experiment, tilting uplift, graded river

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Magnitude-frequency distribution of hummocks and its geomorphological significance

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Hummocks are conically-shaped mounds formed on debris avalanche deposits after catastrophic sector collapse of mountain (often volcanic) body. The present study investigates the cumulative frequency distribution of hummocks, and discusses its geomorphological significance. Total of 17 debris avalanches are examined in this study. And the result shows a clear relationship between magnitude and cumulative frequency distribution given by (Yoshida, 2015),

$\log_{10} N(x) = a - bx$ (1)

where $N(x)$ is cumulative number of hummocks larger than and equal to x, x is the magnitude expressed by $\log_{10} A$, A is the area of a hummock, and a and b are constants. The constant b is peculiar to each avalanche, with a range of 1-2. When a volcanic mass collapses, it breaks up into numerous rock blocks during movement as a debris avalanche. Hummocks are basically composed from such rock masses, and generally become smaller with distance from the source. Previous studies have proposed simple models involving such progressive breaking up of hummocks (volcanic masses or debris avalanche blocks) due to avalanche spreading. From the above, therefore, the constant b becomes a significant value geomorphologically, reflecting the debris avalanche processes directly, because the values of b imply the rate of increases in frequency of hummocks (or debris avalanche blocks as core(s) of hummocks) with the decrease of magnitude, due to the succession of debris avalanche processes. The difference in the value of b may be controlled by the mobility of the debris avalanches. This is because when the debris avalanche is more mobile, the collapsed/sliding masses and the debris avalanches are more shattered and breaked up during movement till emplacement, resulting in more frequent fragments of debris avalanche blocks (i.e. hummocks). A strong correlation between values of H/L (equivalent coefficient of friction as a representative of mobility of debris avalanches) and b supports the above speculation, which the higher H/L (less mobile) of avalanches yields the lower b value.

(Refereneces) Yoshida, H. (2015) AJG Meeting; Yoshida et al. (2012) *Geomorphology*, 136, 76-87.