Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

HGM22-01 Room:101B Time:May 21 14:15-14:30

Gravel and sand particle stractures on bar surfaces and sediment pulse movements in the Sendai River, Tottori

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A slope failure supplied a huge amount of metamorphic black gravel particles, nearly 8,000 dump trucks equivalent, to a middle part of the Sendai River in 1998. After this event, sediment pulse movements of these black particles along the Sendai River were surveyed several times. As a large flood occurred in 2011 after a long time in the Sendai River, we conducted our survey on sediment pulse movement again; detecting ratios of black particle on bar surfaces through sieving gravel according to phi scale, classifying between black particles and others, and weighing them. We also recorded gravel and sand particle sedimentary structures after Kodama (1994) on bar surfaces through a line sampling method. The result shows intermittent 13 km movements of sediment pulses of 16-32 mm & 32-64 mm particles over 13 years. Moreover, a large flood in 2011 had changed gravel and sand particle sedimentary structures from sand rich conditions to sand starved ones. Sediment pulse movements along the Sendai River depend not only on flood discharges but also on gravel particle sedimentary structures which relate to ”sand rich” or ”sand starved” conditions on gravel bar surfaces: that is size mixture effects.

Keywords: sediment pulse movement, gravel and sand sedimentary structure, surface gravel on river bed, size mixture effect, the Sendai River in Tottori, gravel particles of the Sangun Metamorphic rocks

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HGM22-02 Room:101B Time:May 21 14:30-14:45

Landform changes and flood condition in the upper reaches of the River Azusa, central Japan

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The upper reaches of the River Azusa in central Japan is a braided gravel-bed river running down Japan Alps. They are characterized by frequent landform changes occurring in the riverbed. This study aims to clarify geomorphic processes of the landform changes of the riverbed using geomorphological maps and images of the observation site. The maps were made by surveying in every year from 2007 to 2012. The images were taken with interval shooting cameras at intervals of 10 to 30 minutes in daytime from July to October in 2011 and from June to October in 2012. Major landform changes, such as channel migrations, occurred in 2009, 2010 and 2011. No major landform change occurred during the working periods of the interval shooting cameras. The surveying for the geomorphological maps were carried out in August and October in every year. During the period only small change of landforms was recognized. They occurred in severe heavy rain events more than 120 millimeters per day during the snowmelt flooding season in April and May and/or the rainy season in June and July. In 4 July 2011 water level became higher caused by 50 millimeters per day rainfall. Although on 20 September 2011 more than 140 millimeters per day rainfall was recorded, water level does not rise bankfull stage and only slight landform changes take place. Based on the analysis of geomorphological maps and the profile of the cross section of the riverbed, channel migrations were not caused by lateral shifting of the channels. Burying former channels and excavation of new channels caused channel migrations and/or channel pattern changes on the riverbed.

Keywords: gravel-bed river, landform change, geomorphic process, geomorphological map, River Azusa, Kamikochi

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HGM22-03 Room:101B Time:May 21 14:45-15:00

Landform evolution of the river mouth of Ichinomiya River, southern part of Kujukuri plain

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Landform evolution of river mouth of Ichinomiya River about recent 100 years is revealed by analysis from old pictorial map, old topographic map and aerial photography.

Keywords: river landform, bar, flood, river mouth

Japan Geoscience Union Meeting 2013
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HGM22-04 Room:101B Time:May 21 15:00-15:15

Evolution processes of the Oshika Gorge, in Tottori Prifecture

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In general, nick-zone of a river retreats. But according to previous studies, Oshika Gorge in Misasa, Tottori-prefecture with dynamic equilibrium stage seems to incise vertically. We estimated evolution processes of the Oshika Gorge using in-situ Terrestrial Cosmogenic Nuclides dating (10Be and 26Al) to determine dominant erosion mode; retreating or down cutting mode. The bedrock of the gorge consists of granite. We collected 12 granite samples from surface of erosional terraces; 8 samples were collected at A site. And We extracted one sample at a time at B˜E points. At A site, strath terraces developed 7 terraces and present streambed. Incision rate of A site is calculated to be about 0.25mm/yr. But B, C and D sites are calculated to be 1.31mm/yr, 1.38mm/yr, 5.28mm/yr, respectively. E site is calculated to be 5.28mm/yr. These results suggest down cutting mode fits the Oshika Gorge from incision rate of B, C, and D. Uplifting rate of the Chugoku-Mountains estimates 0.1mm/yr (Ohmori, 1980). Incision rate of the Gorge is ten times faster than uplifting rate.

Keywords: Nick zone, Downcutting process, in-situ cosmogenic radionuclides, Incision rate, Oshika Gorge, Dynamic equilibrium

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HGM22-05 Room:101B Time:May 21 15:15-15:30

Late Quaternary development of terraces in the Kumkol Basin at the northeastern Tibet as constrained by in situ CRNs

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In the Kumkol Basin at the northeastern margin of the Tibetan Plateau are well developed fluvial and fluvio-glacial fans and terraces, which have been deformed by many faults and folds in association with the lateral growth of the Plateau. Therefore the Kumkol Basin is one of the most important areas to understand the ongoing tectonics of the Tibetan Plateau, but has rarely been studied because of difficult accessibility. Our work is the first attempt to reveal the geomorphological development of the Kumkol Basin.

Our first field suevey was carried out about fluvial and fluvio-glacial terraces (Sijiquan terraces) along the Sijiquan River, where is easier to access than other areas in Kumkol Basin. In this presentation we report the results of geomorphological analysis of the Sijiquan terraces and analyses of in situ cosmogenic radionuclides in terrace deposits, and then we discussed about the development of fluvial and fluvio-glacial landforms of this area in late Quaternary time.

Our satellite-image interpretation of the Sijiquan area revealed that terraces are classified into H, L1 and L2 groups in descending order. Morphological characteristics indicate that L1 and H groups were formed by aggradation in different periods and L2 was formed by degradation. As aggradation processes are strengthened in glacial periods because of increasing production rate of clastic materials under glacial and periglacial environments, H and L1 groups are likely to have been formed in the Penultimate-glacial and the Lastglacial periods, respectively.

We collected samples from H and L2 surfaces and present river floor (PRF) for measuring cosmogenic ^{10}Be concentration. More than 20 quartz grains collected at the surface of each sampling location were amalgamated and then measured. The measured ^{10}Be concentration in the PRF sample was higher than those in some samples collected from terrace surfaces, indicating that the initial value (inheritance) of ^{10}Be concentration (i.e., the value at the time of deposition) has not been constant during the formation of the Sijiquan terraces. We estimate that present-day river gravel contains higher amount of reworked grains derived from older terraces in the drainage due to dramatic change in erosion-deposition processes. This estimation is supported by a satellite-image observation that present-day first-order gullies originate mainly from older aggradational fans within the drainage whereas the source area of aggradational fan deposits extends higher in bedrock slopes.

In order to estimate the inherited ^{10}Be values for aggradational terrace deposits, we carried out grain-by-grain measurements of ^{10}Be concentrations for the PRF sample; the minimum value among 15 grains can be considered as maximum value of inheritance. By using it, we calculated the minimum age of each sample, on an assumption of no surface erosion. The minimum ages of H and L2 terraces are found to be 94 ka and 15.5 ka, respectively. These ages are not in contradiction with our morphological age estimation.

In conclusion, it is likely that, in the Kumkol Basin, the fluvial regime changes from aggradational in glacial periods to degradational in interglacial periods.

Keywords: Tibetan Plateau, Qaidam Basin, Tectonic landform, Surface Exposure Dating, Fluvial terrace

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HGM22-06 Room:101B Time:May 21 15:30-15:45

Formation age and geomorphologic history of the Lonar impact crater deduced from in-situ cosmogenic Be-10

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Impact cratering is a dominant surface modification process on planetary surfaces. In the inner solar system, the large majority of impacts occur on bodies covered by primitive igneous rocks. However, most of the impacts remaining on Earth surface are on different rock types than that of the inner planet and hence geologic knowledges derived from Earth's surface cannot be translated readily. The Lonar crater is a 1.88-km-diameter crater located on the Deccan basaltic traps in India (ca. 65 Ma), and is one of the very few craters on Earth emplaced directly on basaltic lava flows. Therefore, the Lonar crater provides a rare opportunity to study impact structures observed on the basaltic surfaces of other terrestrial planets and the Moon. Since the ages of terrestrial impact structures is an key to understand geomorphological processes following to the impact, various dating methods has been applied to the Lonar Crater such as fission track (Storzer and Koeberl, 2004), radiocarbon (Maloof, 2010), thermoluminescence (Sengupta et al., 1997), and $^{40}Ar/^{39}Ar$ (Jourdan et al., 2011). Yet, a large discrepancy between these methods ranging from ca. 15 to 570 ka has been resulted. Here we report surface exposure ages based on in-situ cosmogenic ^{10}Be in order to obtain a precise age of the Lonar crater as well as to study the geomorphologic evolution of the Lonar Crater. The samples are collected from the topographic highs on the rim of the crater and from the ejecta blanket. In-situ ^{10}Be exposure age together with newly obtained radiocarbon age of pre-impact soil suggest potential problems of previous ages recently reported by (Jourdan et al., 2011) that $^{40}Ar/^{39}Ar$ dates are biased because of inherited ^{40}Ar in impact glass. Systematically young exposure age from the rim samples compared to the samples from the ejecta blanket indicate that the rim of the Lonar crater is being actively eroded. Spatial age distributions observed from the Lonar creator is not the same as the pattern reported from the well-studied Barringer crater in Arizona (Nishiizumi et al, 1991, Phillips et al., 1991), highlighting the different geomorphologic history of the two craters under different climatic and lithologic settings.

Keywords: exposure age, in-situ cosmogenic nuclide, impact crater, Lonar crater, erosion, geomorphology

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HGM22-07 Room:101B Time:May 21 16:15-16:30

InSAR-image observation of landslide surface deformation triggered by the 2008 Iwate-Miyagi Nairiku Earthquake

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SAR (synthetic aperture radar) is a microwave imaging system used to monitor Earth's surface. We found that fringes in the image has the passibility to detect local landslide surface deformation, apart from the deformation caused directly by the earthquake-induced crustal dynamics. And the detected local deromation was considered in overlaying Kurikoma volcanic land condition map (geomorphological map) published by GSI. It was also found that the deformation area is in harmony with the area of pyroclastic deposition from Kurikoma volcano.

Keywords: earthquake, Iwate-Miyagi Nairiku earthquake, landslide, SAR

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HGM22-08 Room:101B Time:May 21 16:30-16:45

Usability of the morphometry of hummocks to estimate the volume of catastrophic sector-collapses

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To conduct risk assessments for low-frequent but large-scale physical processes, such as catastrophic volcanic sector-collapse and associated rockslide-debris avalanches, data from similar events serve as useful reference points. This study investigates hummocky topography as a tool in the estimation of the volume of volcanic sector-collapse events, i.e., the magnitude of the collapse-to-avalanche events. The topographical differences in the debris avalanche fields that might affect the formation of hummocks are examined so as to assess the application of morphometric analysis of hummocks to estimate the volume of the sector-collapses.

Yoshida et al. (2012; Geomophology) described the functional relationship between the size (plane area) and horizontal distances from the source of the hummocks on debris avalanche depositional surfaces using a regression with the equation $A = a \exp(-bD)$. Each avalanche has distinctive intercept and slope values. The intercept coefficient indicates the average initial size of hummocks at distance = 0 km, and show a high correlation with the volume of collapsed masses. Therefore, there is a high potential to calculate the initial average size of hummocks at the source area from the volume of the collapsed mass of the volcanic body. This indicates that the reverse is also possible: we can estimate the possible collapse volume solely from the hummock distributional pattern of a certain avalanche. This study assesses the applicability of the abovementioned a-to-volume relationship to other examples from different topographical settings.

Examples of the ”wide-spread (freely spreading)” type of debris avalanches similar to those in Yoshida et al. (2012), the 1888 and the Okinajima Bandai volcano debris avalanches, were analyzed (Yoshida, 2012, 2013; TJGU). Their a-to-mass volume relationships are accurately described by the empirical relationship of Yoshida et al. (2012). For a similar type of avalanche, the Yotei debris avalanche, the actual a value is slightly larger than the a value calculated from the known collapse volume using Yoshida et al. (2012) equation. However, the volume of Yotei collapse may be underestimated. The author also examined a ”valley-filling” debris avalanche: the Kannongawa debris avalanche. The Kannongawa debris avalanche is accurately described by the Yoshida et al. (2012) equation. Therefore, the empirical relationship proposed by Yoshida et al. (2012) can be considered applicable to many of debris avalanches, albeit with some exceptions. One of the exceptions is the Kisakata debris avalanche. The empirical relationship can be not applied to the Kisakata debris avalanche, where the hummocks are strongly regulated by the topographical complexity of the debris avalanche route.

Keywords: sector-collapse, hummocks, landforms

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Threshold of uplift rate in the experiments of landform development with rainfall-erosion and uplift

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A series of experiments with rainfall-erosion and uplift of various rates suggests the existence of threshold uplift rates, across which experimental landforms show different aspects of development. A mixture of fine sand and kaolinite compacted in a square-prism-shaped container (60x60x40cm) is pushed out at a constant rate from a flat surface under the artificial mist-type rainfall. In the experiment with a low uplift rate below the lower threshold, drainage networks develop as the surface slowly uplifted. The erosion is exclusively fluvial and no slope, on which failures occur, develops. The maximum height of the surface increases with the uplift while a remnant of flat incipient surface remains, but this increase stops when the fluvial erosion becomes effective on the whole surface. The erosion on the top of low hills where the fluvial erosion works least balances with the uplift. The bottom of major valleys, where the fluvial erosion works most, is considered to have become stable at this point and no further downcut is expected. In the area between the bottom of major valleys and the top of hills, on the other hand, the erosion slightly exceeds the uplift, resulting in slow decrease of average height. A certain low characteristic relief determined by the mound erodibility and rainfall intensity develops and lasts for a long period. When the uplift rate becomes higher than the lower threshold, slopes appear at valley sides (and faults) while drainage networks are developing. After drainage networks develop, uplift exceeds erosion in the upstream area where fluvial erosion works less. Hills grow higher and slope processes, especially failures, become significant. Two types of slope failures are observed. One is relatively small failures which occur on the upper part of slopes. Surface material on the upper part of slopes absorbs much water and falls down with its own weight. Another is large scale failures observed after large and high slopes develop with rapid uplift. A whole slope collapses when its base is eroded away. The former small failures occur any time when slopes of a certain height form, and do not affect the average height unless yielded debris are carried out from the uplifted area by fluvial processes. Debris deposited in the uplifted area, however, tend to increase the gradient of streams enhancing the ability of transport. This means that sediment supply from slopes and erosion by streams would balance to form relatively stable relief and height. In the case of the latter large failures, debris from slope failures flow down as debris flows directly out from the uplifted area (even out from the deposition area when its width is narrow), and reduced relief and height significantly. This type of large slope failures occurs intensively at certain intervals depending on the rate of uplift. The surface rises and the relief increases with the uplift between the periods of intensive large slope failures, and the mound height and relief may show oscillating changes around a certain value corresponding to the rate of uplift. However, considering the magnitude of change and the length of interval, it seems difficult to call this condition 'steady state.' 'Quasi steady state' might be an adequate name for this phase of experimental landform development, including the landform development dominantly with small slope failures. If the uplift rate becomes even higher and crosses the possible upper threshold, uplift overwhelms erosion and hills grow into high mountains until the relief (and height) hits the limit determined by the width of deposition (as well as uplift) area and the strength of mound forming material. Whenever the uplift ends, the experimental landform starts decreasing its height and relief exponentially, and a peneplain-like surface appears finally after a very long period of erosion.

Keywords: rainfall-erosion experiment, landform development, threshold uplift rate, slope failures, quasi steady state, limit of mountain growth

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