

HGM021-01

Room:301A

Time:May 25 14:15-14:30

High-resolution multibeam bathymetric surveys of outer reef slope

Hironobu Kan^{1*}, Masayuki Nagao², Yosuke Nakashima³, Kazuhisa Goto⁴, Nobuyuki Hori⁵, Yusuke Yokoyama⁶, Atsushi Suzuki², Shin Takada⁷, Kouichi Nakano⁷

¹Okayama University, ²Geological Survey of Japan, AIST, ³Ariake National College of Technology, ⁴Chiba Institute of Technology, ⁵Nara University, ⁶University of Tokyo, ⁷Toyo Corporation

The complex topographies of outer reef slopes such as spurs and grooves are hard to visualize by single-beam echo sounder because of their three-dimensional shape. This study attempts to observe 3D measuring and mapping of outer reef slope using high-resolution multibeam bathymetric sonar.

We introduced R2Sonic 2022 Broadband/Wideband Multibeam Sounding System to Okayama University in November 2010. This system is a shallow-water multibeam echo-sounder with selectable operating frequencies within the 200 to 400 kHz band and variable swath width from 10 to 160 degree. Within the acoustic sector, 256 receiver beams were formed using 1 degree across beamwidth x 1 degree along beamwidth. It may also rotate the swath sector either port or starboard side of the vessel. The main part of the sonar has a vertical resolution of 1.25cm.

The system is operated with Hemisphere VS111 GPS Compass and Teledyne TSS Dynamic Motion Sensor DMS-10. The accuracy of VS111 GPS Compass is 0.6m in distance and 0.15 degree in direction when placing A30 and A20 antennas at 1m interval. The accuracy of DMS-10 Motion Sensor is 0.07 degree in roll and pitch, and 5cm in heave. The vertical accuracy of the system is around 5 to 10cm.

The survey and data processing are carried out by the hydrographic survey software Hypack 2010. The visualization of the 3D bathymetry model is conducted by IVS 3D Fledermaus.

A preliminary survey was carried out off the southern coast of Kume Island in November 2011. The maximum depth in the survey area is 280m. The precise reef topography is measured and visualized by this system. The high-resolution (between 0.7 to 1m mesh-size) image is observed above the depth of 60m and the highest-resolution (between 0.1 to 0.5m mesh-size) image is observed around the 10m depth line. The bathymetric result was confirmed by underwater surveys using SCUBA. The high-resolution multibeam bathymetric sonar will be an effective tool to improve shallow water geomorphology.

Keywords: bathymetric survey, multibeam sonar, coral reef, reef slope, Kume Island, Ryukyus

Japan Geoscience Union Meeting 2011

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

©2011. Japan Geoscience Union. All Rights Reserved.



HGM021-02

Room:301A

Time:May 25 14:30-14:45

Fluvial landforms of mountain rivers in Grande Terre, New Caledonia

Hiroshi Shimazu^{1*}

¹Rissho University

This study aims to discuss fluvial landforms and sediment transport processes of mountain rivers in the south Pacific islands. The author carried out the primary exploration on Grande Terre, New Caledonia. This paper is the first report of that.

Keywords: gravel bed river, mountain river, fluvial landform, Grande Terre, New Caledonia

HGM021-03

Room:301A

Time:May 25 14:45-15:00

Formation of dry sand avalanches in Tottori Sand Dunes, southwest Japan, in humid temperate climate

Yoshinori Kodama^{1*}, Ayaka Bitou²

¹Fac.Regional Sciences, Tottori Univ., ²Tajima Shinkin Bank

In the Tottori Sand Dunes, in southwest Japan, a phenomenon called *Sand Curtains* is sometimes observed; these sand curtains are basically dry sand avalanches that occur on calm pleasant days after a rainstorm. They are observed on the upper parts of the leeward slopes of transverse dunes. They are usually ca. 10 cm wide and 3 m to 6 m long. At such times, the color contrast between the dry sand avalanches and the wet slip-face slope is so clear that the tongue-shaped avalanches together resemble a curtain. After several days, with the increase in the dryness of the slip face slope, the dry sand avalanches become larger: up to 2 m wide and 20 m long. By this time, both sand avalanches and sand slopes have dried, and no sharp contrast is observed.

Flume experiments were conducted to investigate the dynamics of dry sand avalanches observed in sand dunes that appear in humid regions such as coastal areas. The flume, which was 40 cm wide, 10 cm deep and 200 cm long, was tilted to 32 degrees. A 4-cm-thick layer of sand with 0.2 mm-0.5 mm particle size was laid out in the flume, and moisture was added to the sand using a spray gun. On the top 40 cm of the flume, wet sand was added to make a steeper slope of 38 degrees. Then, a hand-made heater was placed over this part to dry the sand.

After several hours, with the drying of the sand by the heater, sand failure occurred on the steeper slope because the angle of slope exceeded the angle of repose. Subsequently, miniature dry sand avalanches were observed, which eventually escalated to collectively form a sand curtain. After one day, the slope sand moisture evaporated, the entire slope surface dried, and the size of each successive dry sand avalanche started increasing. We analyzed the grain size of samples from various microtopographies of the sand avalanches. The results showed that the coarser sand accumulated at the marginal and head parts of the sand avalanches, which is consistent with field observations. This suggests a reason for why sand avalanches stop moving on the constant gradient slopes: particle size segregation occurs in an avalanche body in motion; this increases the internal friction, as a result of which the avalanche stops moving.

Keywords: dry sand avalanche, avalanche formation experiment, Tottori Sand Dunes, sand curtain, angle of repose, particle size segregation

HGM021-04

Room:301A

Time:May 25 15:00-15:15

Stream-head migration in the head hollow of the hills :A preliminary observation in the western Kanto Plain

Yusuke Sato^{1*}, Toshikazu Tamura², Takahisa Machida¹

¹Geo-environmental Science, Rissho Univ., ²Geo-environmental Science, Rissho Univ.

Head hollow formed with colluvium is recognized in every valley-head, in which through-flow concentrates from surrounding upper slopes and promotes the initiation of stream. The head hollow contains narrow and shallow depressions (subhollows) which seem to have been formed and maintained with the repetition of excavation and burying. Proportion of micro-geomorphic units composing a valley head varies according to condition of throughflow concentration, which may have close relationship with morphometry and subsurface structure. Therefore both field observations and topographic measurement were carried out in order to compare the relationship between relief ratio and basin length of the first-order valley, which represents the condition of throughflow concentration, in a few hundred valley heads distributed in the hills which were composed of the Neogene or lower Pleistocene sedimentary rocks in the western fringe of the Kanto plain.

A few subhollows are distinguished in a head hollow located in the Iwadono Hills which show mordal relationship between relief ratio and first-order stream basin length. A subhollow which is longitindinary divided to the lower and the upper segments with a break of slope is filled with deposits containing gravel derived from the crest slope which is composed of Pliocene or lower Pleistocene gravels. The filling deposits in the lower segments are divided to the following their layers: the lower gravelly layer, the middle loamy layer, and the upper gravelly layer. On the other hand the upper segments show only one gravelly fill layer. Morphologic and stratifreplic interpretation of the subhollow form and deposits as above lead to the following history of the subhollow development: two cycles of excavation and burying were succeeded in the lower segment, while one cycle in the upper one. The repeating excavation and burying of the subhollow is a result of some environmental change in the head hollow and surrounding areas.

Further investigation on chronology and processes concerned with the excavation and burying is expected to provide the information of the environmental change.

Keywords: Valley-head, Micro-geomorphic, Head hollow, Subhollow

Japan Geoscience Union Meeting 2011

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

©2011. Japan Geoscience Union. All Rights Reserved.



HGM021-05

Room:301A

Time:May 25 15:15-15:30

Denudation rates of Abukuma mountains, Japan

Yuki Matsushi^{1*}, Hisashi Makino², Hiroyuki Matsuzaki², Tsuyoshi Hattanji³

¹DPRI, Kyoto University, ²MALT Univ.,Tokyo, ³Geoenviron. Univ., Tsukuba

We determined millennial-scale denudation rate of watersheds underlain by granite and granodiorite in Abukuma mountains, using cosmogenic Be-10 and Al-26 in river sediment. The denudation rates range from 50 to 100 mm/kyr. The granite watersheds show larger rates than the granodiorites, demonstrating the rock control in denudation. We find a negative correlation between denudation and mean gradient of the watersheds. These results may provide a clue to explore the feedback system between bedrock weathering, erosion, and formation of topography.

Keywords: denudation rate, terrestrial cosmogenic nuclides, river sediment

HGM021-06

Room:301A

Time:May 25 15:30-15:45

Effects of uplift rate on the development of experimental erosion landforms

Shunji Ouchi^{1*}

¹Chuo University

Development of experimental landforms is expected to provide some ideas for better understanding of the landform evolution. Experiments with rainfall-erosion and uplift of various rates, in which miniature erosion landforms develop on a square mound of a mixture of fine sand and kaolinite, revealed that the rate of uplift has critical importance on the development of experimental landforms. The results of experiments suggest the existence of two threshold uplift rates, across which experimental landforms show different aspects of development. When the uplift rate is below the lower threshold, a certain characteristic relief determined by mound erodibility and rainfall intensity dominates (characteristic relief phase). Erosion is exclusively fluvial under the detachment-limited condition in this phase. The uplift gradually increases relief through the promotion of "erosion with knickpoints," which is generated by the creation of elevation differences across faults regardless of the surface relief. When relief reaches the characteristic height, "erosion of declining slopes" becomes effective and fluvial erosion starts to increase with slope. Relief tends to stay at this height with the slow uplift, but this does not mean the dynamic equilibrium between rates of uplift and erosion. The stable relief in this phase reflects the characteristic relief determined by the mound material and rainfall intensity independently of uplift rates. The erosion rate with this characteristic relief can be higher or lower than the uplift rate, and the average height may decrease or increase with uplift while keeping relief constant. Although the duration of this change in average height is ultimately controlled by the condition of deposition around the mound, it can be long enough to follow the duration of constant uplift. When the uplift rate exceeds the lower threshold, the uplift starts to exceed the erosion from the upstream most area where fluvial erosion works less. Hills grow until slope failures occur and reduce their height. Sediment supply increases, and the condition of fluvial erosion becomes transport-limited. Slope failures and creep on the slopes inside the uplifted area, which reduce the height of hills, do not change average height unless sediments supplied from slopes are carried away from the uplifted area by fluvial processes. When the uplift rate becomes higher, hills grow more and sediment supply from slopes increases, but the resultant increase in gradients helps fluvial processes carry more sediments. Uplift and erosion become balanced to keep average height constant, and similar landscapes exist for a long time while the configuration of landform changes with slope failures occurring in different places. This state probably is the "flux steady-state," but the continuous changes in landform configuration and gradual thinning of the hills through the process of repeated slope failures give the impression very different from the "topographic steady state." "Quasi-steady state phase" seems to be the appropriate name. When the uplift rate becomes even higher and crosses the upper threshold, the uplift overwhelms the erosion. Hills will grow into high mountains regardless of the condition of erosion or deposition. This phase can be called "mountain building phase." This high rate of uplift could be generated for only short time, because the uplift generating device hit the limit easily, but even in the case of real mountains the uplift of this kind of high rate probably does not last for long time. Although it is still too early to compare the results of experiments with the real landform development, the results of experiments suggest that the ultimate form, toward which landforms develop, changes in relation to the threshold values of uplift rate. During a round of orogeny, the rate of uplift is supposed to change. Assuming the establishment of a steady state on real landforms seems to be very difficult.

Keywords: rainfall-erosion experiment, uplift, landform development, dynamic equilibrium, fluvial erosion, slope processes

HGM021-07

Room:301A

Time:May 25 15:45-16:00

Nonlinear analysis of elevation data of Japan by using multifractal

Tachinami Setsuko^{1*}, Yasuhisa Kuzuha¹

¹Mie University

We are examining elevation data of Japan (Digital Map 50m Grid: 50m) by using multifractal theory. Lovejoy and Schertzer (e.g. Lovejoy and Schertzer, 2007) have developed their multifractal theory; i.e. continuous random cascades or "*universal model*". Their *universal model* uses three parameters, α , $C1$ and H . First, we confirmed that (spatial) Japanese elevation data field is multifractal field by spectrum analyses. Then we tried to identify the three parameters by using one-dimensional double trace moments (DTM; Lavalley; 1991). At the moment, the following results are obtained. (1) α in east-west direction are the same as α in north-south direction (namely, homogenous). (2) α s in island margins is relatively low. (3) Average and standard deviation of α are estimated as 0.97 and 0.34. The mean is quite low comparing to the value estimated by Gagnon et al.(2006). We will examine causes of the difference.

Lovejoy and Schertzer (2007): Scale, Scaling and Multifractals in geophysics: Twenty years on, in "Nonlinear Dynamics in Geosciences", pp.311-337, Springer.

Gagnon et al. (2006): Multifractal earth topography, Nonlinear Processes in Geophysics, 13, pp.541-570.

Lavalley (1991): Multifractal analysis and simulation techniques and turbulent fields, Doctoral thesis, McGill University.

Keywords: multifractal, nonlinear analysis, elevation data, random cascades, spectrum analysis

HGM021-08

Room:301A

Time:May 25 16:00-16:15

Field experiments of limestone weathering: dissolution rates and hydrological conditions

Tsuyoshi Hattanji^{1*}, Sanae Akiyama¹

¹Univ. Tsukuba

To examine dissolution rate of limestone under various hydrological environments, field experiments for dissolution of limestone tablets were performed in Abukuma mountains and Akiyoshidai Plateau. Field experiments in Abukuma Mts. were conducted in 4 sites with different lithological or hydrological conditions around a karst plateau. Another series of experiment was conducted at 4 sites around a doline in the Akiyoshidai karst area. Tablets were buried in soil at depths of 50 cm or 15 cm. Limestone blocks taken from the Abukuma area were used for tablets (diameter of 3.5 cm and thickness of 1 cm), and these tablets were placed in stream sediments or soil more than 2 years. Alkalinity, pH and major ion concentrations were measured every month for stream sites in Abukuma, and soil moisture contents were measured at soil sites. The result indicated that hydrological condition, the soil moisture response, in particular. Unsaturated soil sites give dissolution rate of 0.08-0.10%/year, whereas dissolution rate increases upto 3% at saturated soil sites. Stream sites also give higher dissolution rate (2-6 %/y) except for karst stream where the saturation indices of calcite (SI_c)The dissolution rate increased with decreasing SI_c value is very high (-0.3).

Keywords: limestone, karst landform, field weathering experiment, dissolution rate