

HGM021-01

Room:301A

Time:May 25 14:15-14:30

High-resolution multibeam bathymetric surveys of outer reef slope

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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

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HGM021-02

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Fluvial landforms of mountain rivers in Grande Terre, New Caledonia

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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

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

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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

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

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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

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HGM021-05

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Denudation rates of Abukuma mountains, Japan

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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

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Effects of uplift rate on the development of experimental erosion landforms

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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

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Nonlinear analysis of elevation data of Japan by using multifractal

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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

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Field experiments of limestone weathering: dissolution rates and hydrological conditions

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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

HGM021-P01

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A Geomorphic interpretaion of the inundation history as fluvial response to intervention in the mid-Arakawa

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Both natural processes as big floods and artificial works as embankment, dam construction and gravel excavation were considered intervention to the fluvial system. The inundation history can be geomorphologically interpreted as response of fluvial system to the intervention. Case studies were carried out in the middle reach of the Arakawa, central Japan. Big floods brought sedimentation in a wide range of the alluvial fan. It was followed by big erosion in the fan, which supplies sediments downstream. On the other hand, both embankment and gravel excavation induce abrupt lowering of river bed. The effects of gravel excavation appear in rather limited reach and disappear soon after the work was over, while the effects of embankment continue long.

Keywords: River bed fluctuation, Human-impact, Flood history, Equilibrium, Mid-Aarakawa

HGM021-P02

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Interpretation of landscapes in tectonically active areas using 5 m DEMs from airborne laser scanner data

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GSI is developing the generation of 5 m DEMs from airborne laser scanner (LiDAR) data and the publication of the data as a part of the Spatial Information Infrastructure. Ground conditions under trees or buildings can be observed by the LiDAR 5 m DEMs. Thus the DEMs enable users to grasp little differences in height in residential areas or terrains under forests.

In the work of 1:25,000-scale Active Fault Map in Urban Areas around Nagai Basin in Yamagata Prefecture, we created the color elevation slope images and the anaglyphs, and studied the application possibility of the 5 m DEMs to the classification of terrains such as landslides, terraces, and fans. Moreover, we compared the digital images derived from the LiDAR DEMs and a terrain classification map (the 1:25,000 Active Fault Map of the 2008 Iwate-Miyagi Nairiku Earthquake "Kurikomayama") created by airphoto interpretation.

The anaglyphs with emphasized heights were useful for interpretations of relatively flat areas, i. e., interpretations of tilting terraces by active faults, former canals, and natural levees. The anaglyphs without emphasized heights were excellent to interpret landslides in mountains. The LiDAR 5 m DEMs are most appropriate to interpret middle-scaled terrains, and may be enhanced by the combination with more large-scaled aerial photographs.

Keywords: active fault, landslide, tectonic geomorphology, DEM, LiDAR

HGM021-P03

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Assessment of landslide susceptibility using landslide map

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The slope where the landslide occurred move easier than the surrounding slope, because the slip surface was formed under the slope. The slope where the landslide occurred is called the landslide topography. We think that by analyzing the landslide topography we can assess the landslide hazard. National Research Institute for Earth Science and Disaster Prevention (NIED) published the landslide map in Kyushu Island, Sikoku Island and the main island in Japan. The objective of this research is to clarify geological and geomorphological features of landslide topography in some areas by analyzing the landslide map of NIED for the assessment of landslide susceptibility.

Two methods exist in the assessment of landslide susceptibility that used by landslide map. One is the method of individual landslide assessment for re-activity, the other is the method of the wide area landslide assessment used by the features and distributions of landslide. In this research, we analyzed landforms in Ojiya area, Niigata Prefecture, Japan for individual landslide assessment and in Sikoku island, Japan for the wide area landslide assessment. The reason to select these area is as follows. In Ojiya area, many landslides occurred in 2004 Chuetsu earthquake, and the landslides are already mapped in detail. Sikoku Island seem to be comparatively easy to show geographical and geological landside features because the geologic structures is simple, and landslide distribution is different in each geological units.

We showed the concrete example of each methods of landslide assessment in this research. In the future, we want to assess the landslide susceptibility that accuracy is more high-resolution and better by adding some parameter respectively.

Keywords: Landslide, Landslide map

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Observations of freeze-thaw cycles on rock surfaces in low mountain area

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Rock-surface temperatures were measured on a tor and a large block located below the timberline in the Kobugahara Highlands, an upland plateau composed of granodiorite in central Japan (1300 m a.s.l.). Many blocks in the region originate from core stones distributed on the plateau, and there are several block streams in the valley bottoms. The tor is situated at the upper end of one of these block streams. The large block appears to have detached from another tor. The mean air temperature of the coldest month is -4 celsius degree. Rock-surface temperatures were recorded continually every 30 minutes from December 1, 2002 through December 13, 2004 by thermistor probes connected to miniature data loggers. The results showed that each year can be divided into four periods: (1) a period with no freezing between April and the first half of November, which forms the first part of an annual FTC; (2) a period with diurnal FTC between the second half of November and the end of December; (3) a period with permanent subzero temperatures during January and February, which forms the second part of the annual FTC; and (4) a second period of diurnal FTC during March. These periods can be recognized in other regions, and the length of each period is affected by the latitude, altitude, and local environment. This study revealed that a freeze-thaw environment exists on rock surfaces below the timberline. It is clear that annual changes in the freezing index are large, and that there are large variations in the numbers of FTC and EFTC within the same area. These differences are primarily caused by differences in the depth of snow cover. The diurnal and the annual freeze thaw cycles and effective freeze thaw cycles were recorded at each site. The freezing index of rock-surface temperature showed a marked variability from year to year. In addition, differences in local conditions at observation sites within a given area greatly affected the rock surface temperature. These are important considerations in relation to local weathering below the timberline.