Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

HGM02-01 Room:301A Time:May 23 09:00-09:15

Similarities in relief structure and landforms between Yakushima Island in Japan and Dartmoor in southwest England

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Relief structure and landforms was examined in two granitic mountains, Yakushima Island in south Japan and Dartmoor in southwest England. This study aims to compare these geomorphological characteristics between two mountains which have different geomorphological and geological settings.

Yakushima Island mainly consists of the Yakushima Granite dated at about 16Ma, which intruded into the Kumage formations of the Palaeogene. The highest peak is 1936 meters a.s.l. The area of the island is about 500 sq. kilometers. Dartmoor is underlain by a major batholith dated at 280 Ma which intruded into the sedimentary rocks of the Devonian and the Carboniferous. The area of Dartmoor is about 1000 sq. kilometers. The highest peak is 621meters a.s.l. Yakushima Island has been uplifted since the middle Pleistocene with high rate, whereas Dartmoor is in the tectonically stable environment.

In this study digital terrain model was used for analysis of the relief structure. The standard deviation of altitude in a 1 sq. kilometer unit is used for expressing relief. Each unit square includes 25 lattice points of a grid system with intervals of 250 meters. It is obtained from 1:50,000 scale topographic maps in Yakushima Island area and from a 50m-DTM made by Ordnance Survey Britain (OS) in Dartmoor area.

Although mean altitude and mean relief in Yakushima Island are higher than that in Dartmoor, shape of cross sections and pattern of altitudinal change in relief within each area is quite similar. The both mountains have a circle-like planform and a domelike profile. Relief increases with altitude in lower part of the both mountains. In the higher altitude area which is located in the central part of the two mountains relief decreases with altitude. This shows that relief structure of the both areas is characterized by the higher relief rims and the lower relief central parts. The cross sections of the dissected rivers show that the valleys with steep side slopes are found near the rims of the mountains and shallow valleys with gentle side slopes are found in the central part of the mountains. Although altitude, relief and inclination of slope are quite different between the two mountains, several similarities are found in relief structure and landforms, which could characterize the granitic mountains.

Keywords: granitic mountains, relief structure, landform, Yakushima Island, Dartmoor

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Development of faro topography in the Indian Ocean atoll

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Faro (little ring-shaped reef, miniature atoll) is a circular reef, usually less than 3 or 4 km in diameter surrounding a shallow secondary lagoon of depths generally less than 20 m which is a characteristic feature in Maldivian coral reef. Because faros rise from the lagoon floor and edges of atolls, their mode of formation must differ from oceanic atolls whose foundations extend to great ocean depths (McLean 2011). However , there has been no substantive study of faros in Maldives.

Holocene reef structure and formation process are observed through an ocean-lagoon transect across the atoll-rim by observations of drilling cores and submarine exposure of reef interior at North Male Atoll, Maldives. We found a distinct faro formation during the Holocene reef development in Male Island which is the first report for substantive study on faro development.

The drilling penetrated 53.5m is conducted at the southeastern part of Male Island where former reef-crest lies under the present reclaimed land. Five reef units are defined from lithofacies of the core. In each reef unit, coral-algal bindstone accumulated on the top of loose reef sediments. The top unit is the post-glacial reef. The other four units are the Pleistocene reefs. The thickness of the post-glacial reef is around 8m where the coral-algal bindstone forms the uppermost 3.3m.

The post-glacial reef structure is also observed at a lagoon slope of the northeastern Male Reef from an exposure of reef interior down to 25m deep where a reef failure happened. The exposure composed of the post-glacial reef. The rigid reef structure is observed at the upper 2m of the lagoon-slope. The antecedent atoll-rim topography of the post-glacial reef is shallower at the rim and deeper beside the lagoon in the North Male Atoll.

AMS datings of the coral/algal samples show the development of the atoll-rim reef after 8,000 cal yBP. The upward reef growth in the early to middle Holocene is the same pace with the sea-level rise at the seaward edge and lagoon-ward edge which reached to the sea-level in the middle Holocene. The typical faro topography formed in this stage. The additional upward reef growth observed from drilling core at the seaward edge indicates the middle Holocene sea-level highstand in Maldives. Faro lagoon is buried by loose reef sediments after the middle Holocene.

Keywords: atoll, faro reef, coral reef, drilling core, Holocene, Maldives

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HGM02-03 Room:301A Time:May 23 09:30-09:45

Natural levees and human settlement in the Song Hong (Red River) delta,Northern Vietnam

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The Song Hong (Red River) delta, northern Vietnam, is characterized by huge natural levees in an area of the delta plain known as the West Floodplain where fluvial sedimentation predominates. The natural levees along the Day River, a major distributary of the Song Hong, are larger than those of the main course of the Song Hong. The Day River levees are 3?8 km wide and rise 3?5 m above the adjacent backswamps and have played an important role in human settlements since the late Metal age. We reconstructed the Holocene evolution of the Day River levees to determine their relationship to Holocene sea-level change, delta progradation, and the distribution of archaeological sites on the delta plain. During the early Holocene, the accumulation of sediment discharged by the Song Hong enhanced both aggradation of the levees and river mouth progradation within the drowned valley of the Song Hong. Radiocarbon dates from cores, trench exposures, and archaeological sites record a dramatic slowing of aggradation when sea level stabilized during 6?4 cal kyr BP (the Holocene sea-level highstand). As sea level fell to the present level during 4?0 cal kyr BP, the river mouth prograded rapidly toward the Gulf of Bac Bo (Gulf of Tonkin) and the river channels extended seaward. In the West Floodplain, lateral accretion overtook vertical accretion to generate the present longitudinal profiles of the Song Hong and Day rivers. During this period, human settlements spread across the backswamp and Holocene terrace area, lagging around 2 kyr behind the shoreline migration.

Keywords: accumulation rate, archaeological sites, delta, natural levees, sea-level change

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HGM02-04 Room:301A Time:May 23 09:45-10:00

HOLOCENE ENVIRONMENTAL CHANGES IN KHUDER PEATLAND, NORTHERN MONGOLIA

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Holocene paleoenvironment in Khuder peat bog, the northern Mongolia was reconstructed by diatom and pollen analyses on peat boring samples. Diatom records of two boring cores showed a general chronology of peat land development from stream environments, marsh and then to the present acidic peat bog established as early as in the mid Holocene. Pollen and diatom records revealed Mid-Holocene drought from 6,000 to 3,000 cal yr BP and its periodic extent was correlative with other studies in Mongolia and the southern Siberia.

Abrupt changes of water environment and vegetation observed are associated with global climatic changes such as the Bond events occurred in North Atlantic Ocean. Cooler period of Little Ice Age and the warmer period of Medieval Warm Period were also remarkably manifested respectively as dry and wetter spells implying a strong connection of climate changes around the Northern hemisphere. However, climate changes contradictive with the results of other studies were also often observed, so the geographical features, pedology and orography should be the key control factors for the moisture balance of the area. We inferred that the observed climatic changes would be reflecting displacement of continental dry region as the study area is located in the transitional vegetation zones between Siberian taiga and Mongolian arid steppe.

Keywords: Northern Mongolia, Holocene, Climate change, Peat sediment

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HGM02-05 Room:301A Time:May 23 10:00-10:15

Disastrous flood events found in lacustrine sediments around Lake Biwa

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Lacustrine sediments have high-resolution regional environmental records on lake and its surrounding catchments in addition to global information. Therefore they are of great use for reconstructing past hydro-environmental fluctuations and understanding lake-catchment processes. Lake-catchment systems with many instrumental stations are of great use for past environmental reconstruction in detail and process-understanding of the systems (e.g. Lake Biwa).

Here we discuss about hydro-environmental fluctuation in the instrumental observation period on the basis of physical properties of sediments. Some sediment core samples were obtained with 1-m sampler in Lake Biwa and Lake Yogo, central Japan.

Analytical results for the core sediments, obtained in Lake Biwa, show that disastrous flood events, Isewan Typhoon (1959) and Meiji heavy rainfall (1896), are clearly recorded in physical properties of sediments; density and mineral content are good proxies of rainfall intensity (100mm excess rainfall); and grain size distribution in lakes may be a function of rainfall intensity in the catchment and transporting distance from the river mouth. Additionally, we compare results of physical properties of sediments in Lake Biwa with those in Lake Yogo during the flood events in detail.

Keywords: flood event, lacustrine sediment, lake-catchment process

Japan Geoscience Union Meeting 2012
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HGM02-06 Room:301A Time:May 23 10:15-10:30

Impact of volcanic activity on Late Holocene sedimentation pattern of a river-lake system in Hokkaido

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Sediment production and sediment transfer through fluvial systems into oceans is very high on the Japanese Islands compared to other regions of the world, as most rivers in Japan are relatively short, show high gradients and are disturbed by human activity. In this study we reconstruct the sedimentation history of the floodplain of Bibi River and Lake Utonai to analyse the impact of volcanic activity on this river-lake system located in Southern Hokkaido. Bibi River is 17 km long and its catchment of 88 km2 consists of the Eastern slopes of the active volcanic complex Shikotsu-Tarumae. The flat, 4.1 km2-large floodplain formed 3000 years ago after the regression of the Pacific Ocean. Bibi River drains into the North-Eastern section of Lake Utonai, which has a total area of 2.3km2 with a maximum depth of 1m. During the last 3,000 years the catchment has been continually used for agriculture and was systematically developed since the beginning of the last century.

To analyze the volcanic impact 6 cores on the floodplain and 7 cores in the lake were taken. To distinguish between air-fall sediment and fluvially transported sediment the cores were sliced into 3cm or 5cm thick samples. For the 620 samples the parameters dry density and ignition loss mean grain size, sorting, skewness and kurtosis were determined.

Three air-fall deposits were identified as Ta-a (1736 A.D.), Ta-b (1667 A.D.), and Ta-c (3000 yBP) which each deposited 1.4 Mio t to 1.8 Mio t sediment on the floodplain and in the lake. Layer thickness on the floodplain depended on eruption direction. For the lake deposits, lake currents seem to focus of the air-fall tephra during flotation. About 0.6 Mio t of fluvial sediment was deposited on the floodplain during the last 3,000 years. During the period 1667 A.D. ? 3,000 yBP an average of 0.070t/ha/y were deposited with an increasing sedimentation rates downstream. During 1736 A.D. and 1667 A.D. an average of 1.5t/ha/y accumulated on the floodplain with highest rates in the middle reach. Sedimentation rates decreased to 0.69t/ha/y during the recent period (2006 A.D. - 1736 A.D.), but showed very high values near road construction sites of the last century. Lake deposition reached 0.05t/ha/y (present - 1736 A.D.), 0.47t/ha/y (1736 A.D. to 1667 A.D) and 0.04t/ha/y (1667 A.D. to 3,000 yBP) with highest sedimentation rates in the northern section due to sediment focusing.

Results suggest that the sediment stored on the floodplain and in the lake is dominated by air-fall tephra (4.6 Mio t out of 5.2 Mio t). Even though the catchment was disturbed by human activity only very little fluvial sediment was deposited on the floodplain or in the lake after the Ta-a eruption. This indicates that mid-Holocene coastal plains can significantly reduce sediment transfer through fluvial systems into oceans by buffering sediment on floodplains and lakes. This finding might not only apply to the study area, but also to other volcanically disturbed catchments with mid-Holocene coastal plains. In such systems the impact of volcanic activity may dominate over human and climate impact.

Keywords: volcanic impact, river, lake, Late Holocene

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HGM02-07 Room:301A Time:May 23 10:45-11:00

Leachability of heavy metals and arsenic in soils due to contamination of disposal cement building materials

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Today, concrete is used in everywhere. These concrete structures get moved away when they end their roles, a very small amount of concrete is left and the soil pH rises. Some geological layers inherently contain substantial amounts of heavy metals and previous studies show us that heavy metals in natural sediments sometimes cause soil pollution. Thus, the heavy metals tend to be leached out from these sediments according to the difference of pH conditions. This study focuses to find out the interrelation between the amount of heavy metals and pH differences. The leaching test is carried out using soil and mortar samples with several mixture proportion. The liquid and solid proportion is 1:10. After 6h shaking, the soil water samples were extracted and pH and EC were measured. Then, heavy metal contents were measured using ICP-MS and ICP-AES. Results are as follows; most of heavy metals (Al Fe Mn Se and As) are leached out and the contents are higher in higher pH and lower pH. Therefore, it will be necessary to measure the soil pH condition when concrete and cement materials were used in the structure.

Keywords: leaching, heavy metals, arsenic, soil, cement

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HGM02-08 Room:301A Time:May 23 11:00-11:15

Experimental study of rock strengthening tuff, limestone, and andesite by using nanolime and other consolidants

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This study is focussing to the efficiency and evaluation of up-to-date consolidants (a non-aquaeous collodial nanolime (Ca(OH)2) suspension, a well-known oligomeric tetraethoxysilane product (Wacker SILRESR BS OH 100), an extremely low viscous epoxy resin (Araldite 2020) and for cultural heritage the most frequently used thermoplastic acrylic resin (ParaloidTM B-72 or also called AcryloidTM B-72) which is known from its good durability, high transparency and non-yellowing film-properties for the consolidation of Oya-tuff. The consolidation effect of nanolime particles were also studied on Ryukyu-limestone and Indonesian basaltic andesite.

The actuality of this study is given by the fact, that degradation (corrosion) of the rocks is incredible speeded up in the last decades by the increased air-pollution e.g. acid rain etc. This makes the stone buildings, objects and sites much more vulnerable. The stone material weakens and looses its original binder to a considerable depth. Consecutively many stone historical constructions require consolidation, conservation and restoration in recent days.

The consolidants were tested by the measurement of tensile strength, Equotip surface hardness, p-wave velocity.

Keywords: Rock strengthening, nanolime, resin, tuff, limestone, andesite

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HGM02-09 Room:301A Time:May 23 11:15-11:30

Difference in surface-stone dislocation by ground cover on wind-beaten slopes in temperate low mountains in winter

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Hillslopes below the tree line, which is usually protected from frost action with vegetation cover, are subjected to seasonal periglacial mass-movements when vegetation is removed by, e.g., strong wind and/or human activity. Among various factors which may control the occurrence of such azonal periglacial processes on wind-beaten slopes in temperate low mountains, we took notice of ground-surface condition.

There is wind-beaten bare ground near the Goreibitsu pass in northeastern Japan forest zone (c. 900m a.s.l., 37.5N) . While mean annual air temperature is 7.3 degree, air temperature in winter reaches about -10 degree on the bare ground. This bare ground is composed of four layers/horizons; I: Angular flat stones with no matrix; IIA:Very dark brown humic clay loam(Sand 8.9%, Silt 78.5%, Clay 12.5%)with few angular stones;IIAB: Dark brown clay-loam to loam (Sand 1.1%, Silt 79.3%, Clay 19.6%) with common angular stones;IIC: Dull brown to dull orange brown loam (Sand 9.7%, Silt 76.2%, Clay 14.0%) with many angular stones. IIA remains only under vegetation around the bare ground.

We observed air temperature, ground surface temperature, ground temperature and dislocation of surface stones (Layer I) in four winter seasons from 2006-07 to 2009-10. Dislocation of surface stones was observed by changes of the nine painted lines. Length and dominant angle of these lines are 8.3-25.3m and 6-20 degrees respectively.

Ground-surface condition is divided into the following two types: one is the C type, which is covered with thick Layer I, and the other is the F type, where small stones scattered on almost exposed IIAB. We applied the division to the record of surface-stone dislocation in 2007-08 winter.

Records of ground temperature show that freezing and thawing repeated only in the upper part of IIAB horizon at several, not all, points. Mean values of stone dislocation in a winter on C type and F type ground surface were 0.35m and 0.52m, respectively. It is obvious that a bigger dislocation occurred on F type ground surface than on C type one.

The difference is considered the consequence of more intense and frequent occurrence of freezing and thawing on F type ground surface where IIAB almost exposes than on C type one where IIAB is continuously overlain with stones (Layer I). On both types of ground, freezing and thawing which are the major driving force of surface stone dislocation occur in the upper part of IIAB. Differential occurrence of surface stone movement is thus considered the results of differential response of fine earth layer with or without stony cover to freezing temperature. It seems one of the characteristics of periglacial mass-movements on slopes in temperate low mountains.

Keywords: Solifluction, Surface materials, Low altitude mountain slopes

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Terrestrial laser scanning of cliff face at Kegon Falls

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Mechanisms of bedrock erosion at waterfalls have been studied so far for several cases, but there remain some uncertainties in erosional processes with regard to detailed form of rocks composing a waterfall. In this study, detailed form of cliffs around Kegon Falls in Nikko, Japan is examined using a terrestrial laser scanner (TLS). Kegon Falls has a total hight of 97 m, with a vertical drop of surface water and outflows of underground water at the lower portion of the cliff. The form of cliffs around the waterfall was measured using a TLS (Topcon GLS-1500) from an observatory facing the waterfall, and the obtained point cloud was georeferenced using a GNSS-based position coordinates of measurement targets. The point cloud was then rotated in order to create a digital elevation model (DEM) on a vertical plane. Longitudinal and transverse profiles were then extracted from the vertical DEM. The stability of the collapsed portion in the cliff indicates that the collapse in 1986 could have likely occurred with crack propagation along joints within the former cliff. The stability analysis also suggests that catastrophic collapse of whole of the waterfall face seems to hardly occur, because the igneous rock composing the cliff is strong enough to keep its current overhanging shape. Actually smaller-scale collapses of the cliff face have occurred in recent years. Whereas, frequent occurrence of freeze-thaw weathering seems to be responsible for the formation of a depression at the bottom of the uppser cliff of lava. The load and tractive force by surface water flow (up to 100 t/s when flooding) may support faster removal of rock blocks behind the water drop. Multiple processes are thus responsible for the erosion of the cliff face of Kegon Falls.

Keywords: waterfall, erosion, bedrock, cliff, terrestrial laser scanning

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Geomorphic Evidence of Uplifting Associated with Old Kanto Earthquakes Before 1703 in a Coast of Miura Peninsula, Japan

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The 1923 Kanto earthquake (M7.9) and the 1703 Kanto earthquake (M˜8.2) were two of recent great earthquakes generated by the slip on the boundary between the subducting Philippine Sea plate and the overlying plate. These earthquakes devastated the southern Kanto area, resulting in more than 105,000 deaths mainly in Tokyo in 1923 and in more than 10,000 deaths in 1703, respectively.

In 1923, the amount of the coseismic uplift was measured as ˜1.5 m in the southern part of the Miura and Boso peninsulas. On the other hand, in 1703, the amount of the coseismic uplift was measured as ˜1.5 m in Miura and 4-5 m in Boso, respectively, from the emerged wave-cut-bench and -notch, and the fossil remains along the coast [eg., Matsuda et al. (1978), Shishikura et al. (2007)].

In Miura Peninsula, in additon, three additional steps of marine terrace surface are formed at 7 to 20 m above MSL, at ˜5200,˜3300 and ˜1500 cal. BC, and these are called Nobi 1, 2 and 3 in order from top [Kumaki, 1985; 14C Age was calibrated]. These terraces are inferred to have been formed with coseismic uplift. In addition, two or three additional steps of marine terrace surface are identified in the levels between the Nobi 3 and 1703 emerged coast at the Bishamon Bay in the southern tip of the Peninsula [Geographic Department of Geographical Survey Institute, 1981]. However, the formation date is very poorly taken. Recently, at the head of Koajiro bay in southwestern Miura, tsunami deposits associated with pre-1703 earthquake was dated between 1060 and 1400 cal. AD [Shimazaki et al. (2011)]. However, the amount of uplift is not studied.

We need to know the amount of the vertical crustal movement and the occurrence date for the Kanto earthquake prior to 1703, for better understanding the earthquake cycle, and thus to estimate the average recurrence time and the magnitude of earthquake for estimating the future earthquake hazard. So we sought the trace of the crustal movement along the coastal region in the southwestern Miura Peninsula. To identify the uplifts associated with recent great Kanto earthquakes, we made a high-density (50 cm mesh) digital elevations map by aerial measurements of the Light Detection and Ranging (LiDAR) in southwestern coast of the Peninsula. In addition, we analyzed air photos taken in 1946, 1963 and 1966.

As a result, five to six steps of marine terrace surface were observed between the Nobi 3 surface and the present coastline, including the 1923 and 1703 emerged terrace surfaces, in the alluvial valley. These terrace surfaces are edged in a small cliff of the height of 1-2 m. In addition, LiDAR data indicate flights of wave-cut-bench on rocky coast (8 m above MSL) in Jogashima, southernmost tip of Miura. These marine terrace surfaces may indicate additional evidence of the uplift associated with the Kanto earthquakes.

Compared the 1:25,000 of old topographic map made in 1921 by Land Survey Department and in 1966 by Geography Survey Institute, the regradation of the coastline is identified in the coast area of Miura. The coastline was shifted from the land side to the sea side, thus the zone between 1921 and 1966 coastlines was dried from the sea to the land. At the bay head of Koajiro, the sea was dried up approx. 300 m in the length. The lowest level of terrace surface which was identified from LiDAR Data and old topographic map have been formed by 1923.

Keywords: Pre-1703 Kanto Earthquake, Recurrence time, Amount of Uplift, Marine terrace sruface, Coastline