The influence of weathering on landslides in some granitic areas of Japan

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Landslides occurred in granitic rock areas are somehow affected by different weathering processes. However, only the climatic condition such as rainfall intensity was investigated well but weathering degrees are not quantified in the most of previous researchers. The present study describes weathering degrees by analyzing chemical and mineralogical properties, and considers their effects on landslides. Samples for analyses were collected sequentially from fresh to strongly weathered. Total 54 samples from Hiroshima (Hiroshima pref.), Nagiso (Nagano pref.), Yamaguchi (Yamaguchi pref.), Minakami (Gunma pref.), Iwakuni (Yamaguchi pref.), Yamada (Kagoshima pref.) and Ishigaki (Okinawa pref.) granitic areas were analyzed by using XRD (X-ray powder diffraction), Scanning Electron Microscope (SEM) and Energy Dispersive X-ray Spectrometry (EDS). As a result, typical weathering trends were observed by comparing both chemical and mineralogical data. The chemical changes like the concentration of K_2O, Na_2O, CaO, MgO, Al_2O_3, SiO_2, FeO changes and the presence of kaolinite, illite, smectite, vermiculite, chlorite along with quartz, k-feldspar, plagioclase, mica also showed the major causes of the formation of clay minerals.

Keywords: Granitic rocks, Weathering, Chemical and mineralogical properties, Clay minerals, Landslides

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Temporal variation of filling processes of valley-head hollows in the Ohmatsuzawa Hills, Sendai, northeastern Japan

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A valley-head area is structured by several micro-landforms, each of which expresses hydro-geomorphic processes in evolution of hillslopes (Tamura 1974, 2008). Head hollows form from landslides, while subhollows develop from shallow landslides that have shorter recurrent intervals and smaller magnitudes than those for head hollow formation (Furuichi 1995, 2015). Filling or modifying of the scours or depressions constitutes another half of the evolution cycle, but its processes and timing appear to be not fully explored. Geomorphological knowledge on filling of the scours involves implications in geomorphic environment especially in terms of the climate change history. This paper presents field-based observation and analysis on filling processes of valley-head areas in relatively gentle, Neogene sedimentary-rock hills in northeastern Japan.

The Ohmatsuzawa Hills extend between the Naruse and Yoshida River lowlands, about 25 km north of Sendai. The hilltops align along the skyline below the level of 140 m a.s.l. and represent erosional surfaces with gravel beds (Akojima, 1971). The study area of the Showa Man-yo Forest Park is located in western part of the Ohmatsuzawa Hills. The highest and lowest elevations occur on the crest slope at 70 m a.s.l. and in the stream floodplain at 20 m a.s.l., respectively. The local basement is the Pliocene Miyatoko Tuff. Fluvial boulders of volcanic origin are found on some of the hilltops and less often on middle to lower parts of slopes. Eight valley-head areas form in the study area and micro-landforms of channel, subhollow, head hollow, upper sideslope and crest slope are identified and aligned in this order upstream.

Profiles of regolith in test pits and by the cone penetration test show layered structure. At channel heads, for instance, a gravel layer of 40-50 cm thick overlies the weathered (in-situ) Miyatoko Tuff at c.a. 80 cm deep and is occasionally covered by a buried humus layer of 10-20 cm thick. The gravels must have been transported (colluvium) given that patches of buried humus are found within the gravel layer. Spatial extent of the colluvial gravel layer is narrower than the area of head hollow but wider than subhollow. ^{14}C dating of a patch of buried humus within the colluvial gravel layer indicates an age of the middle of the Holocene and ages of a buried humus layer overlying the colluvial gravel layer are younger than the patch of buried humus.

It has been reported that shallow landslides can occur in (relatively steep) upper sideslopes once intensive rain and/or strong ground shake (earthquake) affect the slope stability and therefore evolution in valley-head areas is driven not only by continuous diffusional processes such as soil creep but also occasional mass-wasting (Tamura et al. 2002, 2011). In the preset study area, the colluvial gravels are sourced to the hilltop gravel deposits and were likely transported through shallow landslides occurred across the crest slope and (relatively gentle) upper sideslope. The time of the mass-wasting falls in the warmer (and probably wetter) period in the Holocene, suggesting forest fire and/or intensive rainfall may have caused the mass-wasting although earthquakes are known to induce landslides on convex slopes. The period of the mass-wasting was followed by a static period indicated by development of the buried humus.

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Keywords: head hollow, subhollow, mass-wasting, Holocene, climate change

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Multi-proxy study of alluvial fan development during the Holocene in the Qu`Appelle Valley, Saskatchewan

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Sedimentation on alluvial fans is controlled by fluvial erosional processes occurring in upland drainage basins and slopes, as well as by the subsequent transport processes which deliver the sediments from the catchment area to the fan. Alluvial fan sediments may contain valuable information of climate change, anthropogenic influences and could function as an archive of landscape development. The deposits of the alluvial fans in the Qu’Appelle Valley, Saskatchewan comprise of weathered glacial till and glacial fluvial material transported from the upland drainage basin area. The purpose of this study is to establish a relative chronology of the alluvial fans in the Saskatchewan Prairies by exploring multiple proxies as well as to evaluate the weathering/leaching intensity of the modern upper catchment soil and the borehole core samples.

Two borehole cores (AG850 cm and FN350 cm), which were taken from two Holocene alluvial fans located in the Qu’Appelle Valley in southern Saskatchewan (Kotowich and Hardenbicker, 2014) were used for this study. Core sediment sample collection ranged from 2-10cm based on sediment physical properties. The upper catchment areas of the AG and FN cores have been dominated by agricultural fields since 1890’s and natural prairies accompanied with recent agricultural practises, respectively. Modern surface samples from natural prairie grasslands, agricultural fields, tree groves, and sloughs were also collected from the upland catchments to examine soil properties. Elemental composition analysis using an Energy Dispersive X-ray Spectroscopy was carried out to obtain weathering/leaching intensity of the samples. The Beavers Index CaO/ZrO_2 molar ratio, the Parker Index [(Na)a /0.35]+[(Mg)a / 0.9]+[(K)a / 0.25]+[(Ca)a / 0.7])*100, the Product Index [SiO2/(TiO2+Fe2O3+SiO2+Al2O3)]*100 were focused to quantify the degree of weathering/leaching in semi-arid environment (Souri and Watanabe, 2011; 2013). Particle size distribution, pH, organic content, and radiocarbon dating were obtained for the borehole cores and the surface soils of the upper catchment areas. Features of foraminifera were observed by stereomicroscopy in sediment/soil samples.

The weathering index values showed fluctuations by depth in the borehole profiles, although there was an inverse relationship between Product Index and sample depth. Beavers Index and Parker Index performed a similar fluctuation in the profiles. Borehole samples with smaller Parker, Beaver and Product values also had a larger content of finer particles. Physical features seem to coincide with chemical features. The indexes obtained for the modern surface soil showed differences in land use or vegetation coverage; prairie grassland or agriculture field versus forest or slough, which suggest their behavior as leaching intensity indicators. Foraminifera were also found in modern soil samples from the upland drainage basin of both alluvial fans. Moreover, the presence and abundance of foraminifera varied in the borehole samples. This may suggest that they could be used in combination with weathering indexes as an environmental proxy for reconstructing the environmental history of the Qu’Appelle Valley.

Keywords: Alluvial Fan, Chronology, Canadian Prairies, Holocene environment

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Lithological control on pothole formation in two tectonically active regions within the Deccan Volcanic Province, Maharashtra, India

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Recent studies have shown that the Deccan Upland region of the Deccan Plateau is constituted of different blocks with uplifts, mainly during the Quaternary times. Bedrock incision in streambeds has also been the focus of many recent studies worldwide. This paper talks about the difference in the morphology of potholes within two river channels from two distinct tectonically active regions. These two river channels were made up of distinct lithologies: Nighoj area- Mainly compound flows constituting of dominantly compact and vesicular basalts and Patan area- Mainly simple flows constituting dominantly of flow top breccia. The depth and diameters of potholes formed were measured in the field.
The studies indicate that the potholes formed in the compact and vesicular basalts have an average of 1:1 diameter to depth ratio; whereas in the flow top breccia potholes have an average ratio of 1:6. This indicates that the vertical incision controlling the depth and the lateral incision controlling the diameter of the potholes are nearly equal in compact, vesicular and amygdaloidal basalts, as seen at Nighoj, giving rise to potholes that are deep and have large diameters. At Patan, in the flow top breccia the vertical incision rate is much higher than the lateral incision, as the circular movement of the tools is hampered by the breccia fragments, obstructing the formation of eddies, giving rise to potholes that are small in diameter but have depths that are nearly six times that of the diameter.

Keywords: Deccan Plateau, Bedrock incision, Morphology of potholes, Diameter to depth ratio

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Isolating lithologic controls on landscape morphology in the Guadalupe Mountains, Texas, USA

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Qualitatively, lithologic control on topography is apparent in many landscapes. This is perhaps most notably evident in dryland settings with horizontal stratigraphy, where the contrasting geomorphic expression of “cliff formers” and “slope formers” is common. However, in many geomorphic studies, lithologic contrasts are often acknowledged as important, but are otherwise ignored in attempts to determine tectonic forcing or climatic control. Tectonic inactivity and relatively little spatial variability in climate make the Guadalupe Mountains of Texas and New Mexico an ideal site to investigate the effects of lithology on topography. To determine the effects of lithology, we compared topographic metrics including topographic relief, slope and channel steepness index in different mapped lithologic units across the region. Steepness indices were calculated for approximately 1,050 channels in the Guadalupe Mountains and surrounding area using elevation data extracted from USGS 10m Digital Elevation Models. Individual steepness indices were fitted for distinctive segments along each longitudinal stream profile in order to capture the variability as streams cross potential lithologic contacts. These indices were then grouped per 23 discrete lithologic units, including abundant limestone and dolomite with some evaporites, sandstone, and shale.

We first compared the datasets using the Kruskal-Wallis method for hypothesis testing and found that significant differences exist between the lithologic groups, suggesting potential correlation among channel steepness and lithology. To better evaluate the different rock units, we used published unit descriptions to develop a simple and a semi-quantitative ranking of relative rock erodibility. This ranking system assumes units with evaporates are softer and units limestone and dolomite are harder, with other units, including sandstone and shale in between. This ranking system also accounts for other factors such as relative bed thicknesses, as well as spatial heterogeneity and variety of rock type within a given unit. These objective ranks were correlated with average steepness indices for each of the 23 lithologic units, giving an R^2 value of approximately 0.44, suggesting that steepness provides some predictive ability in determining rock properties. Finally, we show that some of the variability in the relation between steepness and relative erodibility can be explained by effects of stratigraphic order.

Keywords: Geomorphology, Channel Steepness, Lithology, Digital Elevation Model, Topographic Relief, Rock Erodibility

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The Role of Long Term Ecological Research in Understanding Dynamic Geomorphological Systems: Insights from Mountain Environments and Highland Watersheds

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This theoretical paper explores the new concept of integrating research on geomorphological processes and landscape ecology in order to understand dynamic and large geomorphic systems. Ever since the seminal work of Chorley (1962) that analyzed the essentially multivariate nature of geomorphic processes, whole landscape assemblages, heterogeneity, and evolutionary patterns; the idea of open systems is considered important in geomorphology. This approach was later fine- tuned by Thornes and Ferguson (1981: ‘systems of complex disorder’ approach) and Odoni and Lane (2011). A key ongoing debate within this paradigm is: whether concepts of ‘equilibrium’ and ‘equilibrium states’ as descriptors of geomorphic systems are inadequate and should be replaced with the concept of ‘systems in perpetual flux’ (Gregory and Lewin 2014). Another important question is on ‘universality’ versus ‘uniqueness’ of such system properties, with von Elverfeldt (2012) noting that such complex geomorphic systems could be ‘self-referential’. This paper invokes processes in mountain environments and highland watersheds—disturbance regimes in hillslopes, sediment transport in rivers, differential erosion and interplay with biotic and abiotic agents—to illustrate key points of this ongoing debate. Back in the 1970s, it was already asserted that reductive logic would fail to provide meaningful understanding of very complex systems due to the property of ‘synergy’ (Monod 1970). As for equilibrium in large geomorphic systems; Scheidegger (1983) contended with his ‘instability principle’, based on the study on the development of cirques, that the ‘equilibrium’ of geomorphic systems is inherently unstable. Those ideas resonate well with recent research on ‘emergence’ in landscape ecology; where it has been contended that Long Term Ecological Research (LTER) based on monitoring and accounting for change in a landscape over time is fundamental to understand complex system pathways, emergence, and resilience. 'Forward and backward loops' whereby the landscape undergoes periodic energy-buildup, storage, release, and reorganization phases (natural disturbance regime) is another key concept that has emerged from landscape ecological research. Recently, the sub-discipline ‘Biogeomorphology’ (Stallins 1996) has emerged to put the idea of the ‘landscape’ (with its often-chaotic patchwork of sub-components) as a fundamental unit for geomorphic system analysis; with empahsis on the key role of ‘ecological memory’ (i.e. how a set of abiotic and biotic factors is engaged in complex, at times recursive feedback between components) in describing processes. Through his 4R (Response, Resistance, Resilience, Recursion) concept, Philips (2011) has described how geomorphic systems co-evolve with climate, soil, ecosystems and other drivers. In mountain environments and highly active (dynamic) watersheds, abrupt threshold change has been noted for sediment transport and channel formation processes. Eaton et al. (2010) have observed that change- thresholds could be fundamentally ‘fuzzy’ and ‘overlapping’; posing yet more challenge for predictive science. While such developments could appear as erosive for the authority of geomorphology as a descriptor of land-formation, in reality they offer an exciting new vista for geomorphological research. Especially for highland watersheds, river geomorphologists’ long-standing preference for ‘stability’ (under which any change is an ‘anomaly’ and must be ‘normalized’) is increasingly untenable, in the light of recent advances in the understanding of active channel formation and mountain-river-plains interactions. By drawing on the seminal work of Stirling (2010) this paper proposes that understanding large and complex geomorphic

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systems (or processes) need to switch to ‘recursive understanding’, and possibly abandon ‘predictive understanding’ which has functioned as a longstanding goal for geomorphologists.

Keywords: Dynamic and large geomorphic systems, Geomorphic processes, Equilibrium vs. Flux, Disturbance regimes, Highland watershed , LTER

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Stochasticity controls and the central role of “internal variability” in soil erosion system

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Accurate prediction of soil loss rates remains a problem because erosion exhibits a non-unique behavior given the same rainfall/runoff forcing. The effects and causes of uncertainties in soil surface erodibility resulting in such a behavior have not been fully addressed from a mechanistic perspective in previous research. We use a large database of empirical data on soil loss and a comprehensive physical model of runoff –overland flow –erosion –transport processes that dynamically updates the mass and composition of soil substrate at the hydrologic-event scale to address reasons of unpredictability in soil erosion. We explain the role of micro-scale erodibility (referred to here as ‘geomorphic internal variability’) on geomorphic response, which acts as an intermediary between larger-scale forcings and soil loss response. Accounting for a possible range of internal variability illustrates the high sensitivity of erosion response to initial conditions of soil bed, resulting in extremely large uncertainties in short-term predictions. Furthermore, the reduction of geomorphic response variability at larger temporal scales is primarily attributed to a ‘compensation effect’: temporal alternation of events that exhibit either ‘source-limited’ or ‘transport-limited’ regimes. We relate this reduction to a novel stochasticity index that reflects the degree of variability of intra- and inter-event hydrometeorologic conditions. A higher stochasticity index implies a larger reduction of soil loss variability (higher predictability) at the aggregated temporal scales with respect to the mean hydrologic forcing.

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Keywords: Soil erosion, Geomorphic Internal Variability, Geomorphic External Variability, Stochasticity index, Soil erosion variability

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Mediation of sediment dynamic processes by vegetation within a rapidly developing saltmarsh

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Nowadays, the rapid reduction of coastal saltmarshes has become a worldwide problem and the practical needs of restoration and creation require the understandings of the basic physical mechanisms controlling the development of saltmarshes. The pioneer zone has been widely recognized to be the key of saltmarsh development. Generally, the pioneer zone is occupied by pioneer species in the form of dynamic patches or tussocks. The positive and negative feedbacks among vegetation, sediment dynamics and morphology determine the pattern and the rate of saltmarsh development, as a representative case for biomorphodynamic study.

In order to examine the processes and relevant mechanisms affecting the development of saltmarsh pioneer zones, observations over a timescale from vegetation patches to fully developed saltmarsh are in need. The Andong Shoal, located at the turbidity maximum zone of Hangzhou Bay, is a typical area of high sediment supply in the world. The saltmarshes, mainly covered by *Scirpus mariqueter,* are developing at a high rate and thus, it is possible to observe the development of saltmarsh pioneer zone within a relatively short period. Our study attempts to understand the feedbacks between vegetation and morphodynamics from vegetation patches to a fully developed saltmarsh in the pioneer zone of the Andong Shoal saltmarsh. *In situ* observations of sediment dynamics were carried out in two seasons, comparing the bare mudflat, the vegetation patch and the gap between two patches. Meanwhile, *in situ* biological investigations and geomorphological surveys were undertaken.

The preliminary results revealed that: 1) the tidal flat of the Andong Shoal received a large amount of sediments, resulting in a vertical accretion rate up to 50 cm a^{-1}; 2) due to the high sedimentation rate, the patches could convert into a fully developed saltmarsh at a seasonal scale; 3) the geomorphological surveys indicated that both vegetation patches and the gaps between them were depositional; 4) in the pioneer zone, the vegetation patches with diameters of several meters were able to reduce 36% of the flow speed in comparison with the adjacent bare mudflat, whilst the gaps between patches accelerated the flow speed to 157%, as such, a positive feedback occurred within the patches but the negative feedback within the gaps was suppressed by a high sediment input; 5) when the vegetation patches merged together to form a fully developed saltmarsh, the vegetation reduced 65% of flow speed in comparison the previous bare mudflat; and 6) the mean suspended sediment concentration increased after the patches merged together, and this pattern implied that the presence of vegetation patches was likely to be a more efficient sediment trap than the fully developed saltmarsh, in order to accelerate the vertical accretion which was crucial for the saltmarsh establishment.

Keywords: Saltmarsh, Vegetation patch, Sediment dynamics, Geomorphology, high sediment supply

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Consideration of paleolake and paleo-inflow in Olgoi basin, upstream of Valley of the Gobi Lakes, Mongolia.

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Valley of the Gobi Lakes is between north Khangai Mountains and south Altai mountains in Bayankhongor Province, Mongolia. There are several closed lakes such as Böön Tsagaan Lake, Tsagaan Lake and Orog Lake in the valley. Previous geological studies indicated that there was once a large lake, but the geological history of this area has been still unclear. This study focuses on the basin including present Olgoi Lake upstream of Böön Tsagaan Lake flows. We found paleo shorelines in the east of the basin through a satellite image, and reconstructed Olgoi Paleolake, which was 70 times larger and 15 m deeper than present Olgoi Lake. We also numerically simulated the paleo-inflow with criteria regarding the shear stress necessary to transport the gravels measured in the field research. The calculation suggested two orders of magnitude larger discharge than the bankful discharge in the modern period estimated based on the present topography. Although this flow does not seem to occur under present precipitation there, this region should have experienced much wetter environment in the past whether the stream was caused by precipitation or melting of snow and/or glaciers.

Keywords: Valley of the Gobi Lakes, Olgoi Lake, Paleo hydrology, Photogrammetry, Fluid analysis, GIS

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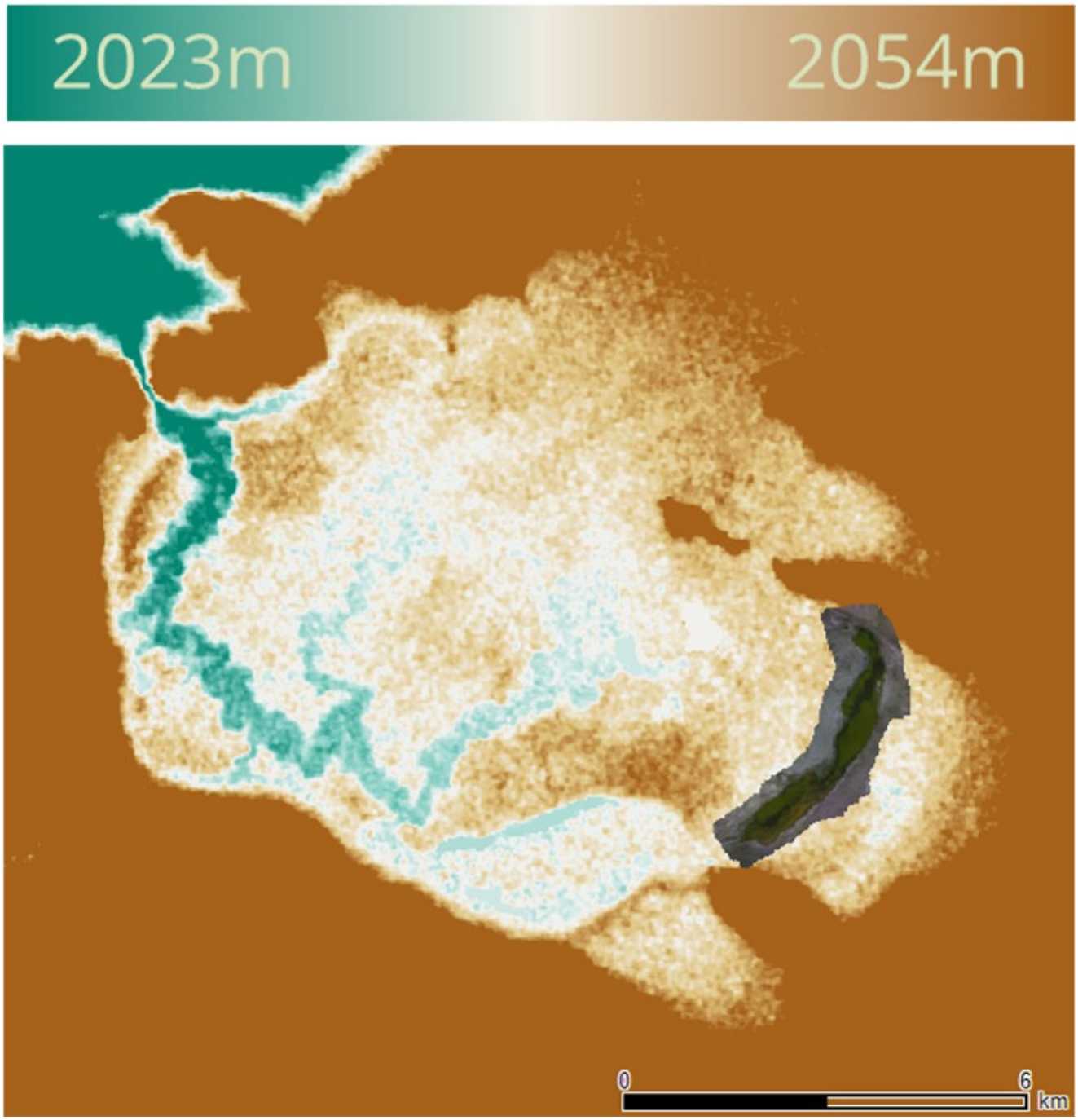

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Land classification in Surkhandarya region, southeastern Uzbekistan

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In the Surkhandarya river basin, southeastern Uzbekistan, there are many Buddhism temple excavations which were established after 1st century. The aim of this study is to clarify the distribution landforms and geomorphic environment in this area as a part of excavation of the Kara-Tepe Buddhism temple, which is one of the most important temples between 1st century and 3rd century.
The land classification map was created by interpretation of counter maps derived by Alos-2 data and satellite images of Google earth. Field surveys were also performed in September 2016 in southern part of the Surkhandarya valley.
The region consists of major five topographic regions: high mountain range, frontal mountain range, Surkhandarya valley floor, central hill, Amdarya river floodplain. The high mountain ranges are including the Hisor mountain range, which is the west extension of the Pamir, the Bobotag mountain range and Kohitangdog mountain range, whose elevation are up to about 4700m. The frontal mountain ranges are located on the front of the high mountain ranges facing the eastern and western fringe of the Surkhandarya valley. They consist of several rows of ranges whose elevation is up to about 1000m. The Surkhandarya valley floor is formed by the Surkhandarya River. That is consists of terraced flat surfaces, alluvial fans formed by tributaries flowing down through the frontal ranges, which includes dissected alluvial fans, the Surkhandarya flood plain. Although terraced flat surfaces are extended, the floodplain along the Surkhandarya is narrow. The central hill divides the terraced flat surface of the Surkhandarya valley. The hill is raised a couple of hundred meters from the terraces flat surface of the Surkhandarya valley and have five levels of backs. The Amdarya river floodplain is several tens of kilometers wide and eroding the lower ends of terraced flat surface of the Surkhandarya valley creating the boundary between Uzbekistan and Afganistan.
After formation of the Surkhandarya valley floor the central part of the valley floor and frontal zone of the high mountain ranges began to be uplifted and formed the central hill and frontal mountain ranges.

Keywords: land classification, fluvial process, uplift, Surkhandarya River, Amdarya River, Uzbekistan

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Designing evacuation drills using GIS-based disaster prevention maps of cultural properties for Hanno City, Saitama Prefecture

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Serious disasters such as the Great East Japan Earthquake of 2011 and the Kinugawa floods of 2015 have highlighted the need for contingency plans to evacuate and rescue important cultural properties. Firstly, it is necessary to identify where and what types of Cultural Properties exist, and then, to know how to evacuate them from disasters. This study aims to identify the risk of damage to cultural properties and design appropriate means to evacuate them during landslide emergencies. Here, we focus on landslide disaster hazard mapping in Hanno City, Saitama prefecture using GIS. Potential landslide risk zones were identified using data provided by the National Land Numerical Information. Nine categories of Cultural Properties, including buildings and natural monuments etc., were mapped using GIS. Three regions: the Hanno City area, Agano area, East Agano area, were chosen for detailed investigation.

Keywords: cultural property, desaster prevension map, Hanno city, GIS

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Geomorphic Characteristics and Settlement Location along the Tsunami-hazardous mid-Sanriku Coast in Northeastern Japan

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In contrast to the north Sanriku Coast where higher marine terraces are well developed, scattered distribution of small terrace patches were formerly reported along the mid-Sanriku Coast. However, most of the scattered terrace patches show the characteristics of piedmont gentle slopes particularly in the zone composed of granitic rocks. We investigated this type piedmont gentle slopes in the Funakoshi Peninsula and its surrounding, and revealed the followings: (1) Gentle slopes of around 3 - 15 degrees are distinguished from steep slopes around the zone of 70 - 90m above the sea-level and are subdivided into the higher gentle slope and the lower ones. (2) The higher ones are composed of deep weathered granite and slope deposits including weathered angular gravels. On the other hand, the lower ones have slope deposits including fresh granitic angular gravels, by which deep weathered layer is truncated. (3) The lower end of the lower gentle slopes are in some places cut by Holocene sea cliffs and the upper continuation of the lower gentle slopes in the back-hills show the dell-like form. The geomorphic characteristics as above suggest the processes of piedmont gentle slope formation in the late Quaternary climate and sea-level changes.
The several landforms along the coast, including near-shore lowlands and piedmont gentle slopes, have been used as the location of fishery and agricultural settlements. Histories of location and relocation of several settlements were retraced. The histories are the results of residents' cognition of geomorphic setting as resources for living including usual fishery and agricultural activity and for evacuation from unusual but repeating tsunami hazard in changing socioeconomic and technologic conditions. The changing residents' cognition can be reassessed from the viewpoint of geomorphologists. The knowledge should be applied to wise use of geomorphic resources.

Keywords: piedmont gentle slopes, tsunami, human activity

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The Experiment of Alluvial Fan Evolution Induced by Debris-Flow Tributary

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Rainfall events with high intensity cause many landslides, slope avalanches and debris flows in Taiwan. As a debris flow flows from a tributary to mainstream, an alluvial fan usually forms at the confluence. Villages and infrastructures adjacent to these alluvial fans are in high risk. The more understanding of the morphological processes of alluvial fans need to be explored for the disaster prevention.
A simplified laboratory experiment is conducted in this study to simulate the morphological process of alluvial fans formed by debris flows at the confluence. The tributary is set to be perpendicular to the mainstream with mobile bed. In fixed volume of debris flow, sediment concentration of debris flow is modified by the different water volume. In mainstream, discharge is altered in distinct amount to erode the accumulation of the debris flow at confluence. By using Particle Tracking Velocimetry (PTV) method, velocities of mainstream and tributary are measured. The impact of flows velocities at confluence can be observed to analyze.
During the process of deposition, the real-time morphological change is recorded by using images analysis. Cameras from different angles of views are used to monitor process. The Digital Terrain Model (DTM) is built to observe morphology elevation evolution through time by Digital Photogrammetry. The results show that experiments might reach a dynamic equilibrium elevation in late stage from an initial stage of elevation growth.

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Laboratory experiment of river terraces formation under tilting uplift

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Formation of river terraces is not simple in response to external forcing. Previous experimental studies showed that multiple terraces can be formed even by a single sudden sea level or a continuous change. It is so far difficult to precisely reconstruct a history of landform development from remaining topographic features along time axis. In this research, we conduct model experiments that allow observation of time development. It was aimed to investigate the timing of terrace formation, temporal change of longitudinal profile of channels and terraces, flow path position, and terrace heights and lengths, in response to temporally-constant tilting-uplift where the uplift rate linearly increases landward.
In the experiment, we simulated bedrock by the mixure of sand and kaolinite at a volume ratio of 10.5 : 1, which was installed into a tank to make an initial flat slope of 1 degree. Sprinklers supply misty rain to develop the topography. During the first 40 minutes, rain was supplied without no uplift in order to promote the development of the terrain for preparation. Later, the following procedures were repeated during the run: both uplift and rain were realized for 20 minutes, and then the run was paused temporally for photographing of topography to make 1 mm-mesh DEM by photogrammetry using more than 200 photos.
Many terraces were formed in the experiment, and we selected a series of eight terraces along a single flow path to analyze. Temporal change of longitudinal profile of the river and terraces showed that the terraces become steep after formation with time due to the tilting uplift, which resulted in a topography where higher terraces dip more steeply relative to the channel profile, as pointed out by a previous theoretical model. A formed terrace could be not only shorter due to lateral erosion, but also longer owing to downcutting of floodplan at downstream side, which means, in some time-scale, a terrace does not necessarily show an isochronal face. The terraces tended to form when both lateral and downward erosion were large.
It is still difficult to predict when and where a new terrace emerges. The terrace formation relates with not only the uplift but also the lateral and downward movement of channel, but it is not clear so far how discrete topographies (i.e., terraces) are made by continuous forcing, which has been called complex response. In this experiment, we confirmed fluctuation of vertical and lateral incision rates through the quantitative measurement, which resulted in oscillation of river bed elevation and presumably triggered the development of discreet landforms. This fluctuation is thought to be an autogeneous phenomenon that does not require meander cutting. While some previous studies pointed out that river bed elevation can fluctuate because of change in sediment production rate due to glacial-intergracial cycles, the present experiment suggests that the river bed elevation can fluctuate even in a low latitude area free from glacier, without strong external forces.

Keywords: terrace, formation

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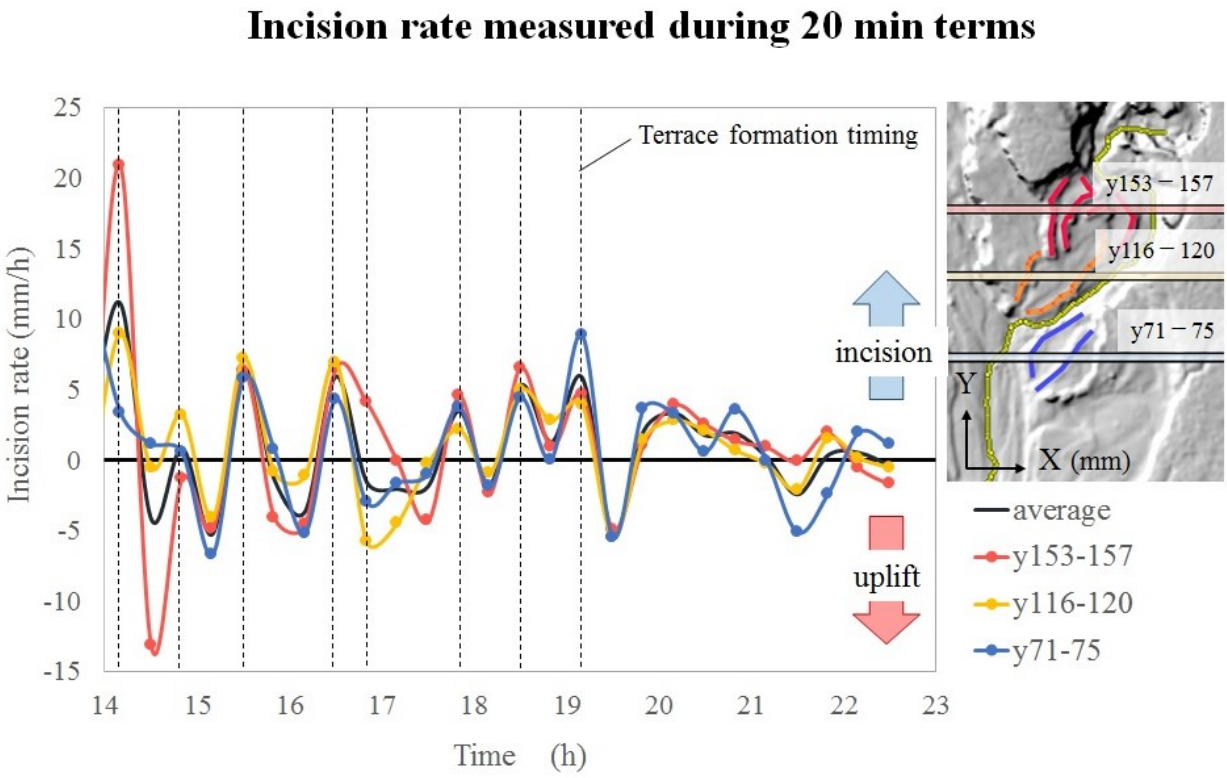

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Geometry and dynamics of braided channels and bars under experimental density currents

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Submarine channels convey turbidity currents, whose deposits are key hydrocarbon reservoirs and indirect records of continental denudation. Submarine channel patterns resemble those of their subaerial counterparts, but controls on the form and dynamics of submarine channels and associated deposits remain comparatively uncertain. Existing laboratory experiments show that braided channels can develop under similarly high flow width-to-depth ratios for both subaerial and submarine conditions. We conducted a new set of experiments with net-depositional density currents to (1) further test the conditions for channel formation; (2) test the response of channel and bar geometry to changes in the ratio of water-to-sediment flux, inlet conditions, and submarine versus subaerial conditions; and (3) quantify the relative timescales of channel lateral migration, abandonment, and aggradation. We generated density currents within a freshwater basin using saline inflows that transported plastic sediment as bedload across a platform 2 m long and 1 m wide. We find that across a 2.7-fold range in the ratio of water-to-sediment flux, submarine braided channels consistently develop, are more pronounced upstream, and can transition to zones of sheet flow downstream. We measured topographic statistics directly, and using a reduced-complexity flow model. The topographic analysis showed that braiding index is higher for subaerial than for submarine conditions with other variables fixed. For a representative submarine experiment, channel lateral motion decorrelated in double the time to move laterally one channel width, and one-third the time to aggrade one channel depth. We propose a new stratigraphic model for submarine braided channels, wherein sand bodies are more laterally connected and less vertically persistent compared to those formed by submarine meandering channels. These results suggest that channel pattern is a key variable for predicting stratigraphic architecture in submarine environments.

Keywords: Geomorphology, Sedimentology, Submarine channels, Braided rivers, Turbidity currents

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