

Japan Geoscience Union Meeting 2011

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HGM002-01

Room:301A

Time:May 25 16:30-16:45

The Holocene Environmental Change at Khuder Peat Land, Northern Mongolia

Yu Fukumoto^{1*}, Kaoru Kashima¹, A. Orkhonselenge²

¹Faculty of Sciences, Kyushu university, ²Geographical Institute, MAS, Mongolia

Holocene development of Khuder peat bog in northern Mongolia was reconstructed from fossils of diatom, pollen, and other chemical proxy records. The diatom records from two boring cores showed a general transition from riverine environments, low marsh to the present acidic peat bog. In this general trend, abrupt changes of water environments were observed. These changes could be correlated with bond events and evidence of arid environment at Little ice age was remarkable. This study demonstrated that the multi cores are necessary to fully reconstruct the paleoenvironment on terrestrial deposits as the diatom records of two cores are not necessarily synchronous. Pollen record showed some transition of vegetation such as rapid expansion of conifer forest at around 6,000 cal yr BP. Coincidence of these events with those of other areas could test the geographical extent of climate changes as the study area is located between the vegetation zones of Siberian taiga and Mongolian arid steppe.

Keywords: Holocene, Climatic Change, Mongolia, Peat Land, Diatom Analysis, Pollen Analysis

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HGM002-02

Room:301A

Time:May 25 16:45-17:00

Preliminary report on limno-geomorphological changes in Darhad Basin, Northern Mongolia

Kenji Kashiwaya^{1*}, DDP Group¹

¹Inst. Nature & Env. Tech. Kanazawa Univ.

Proper interpretation of long-term environmental changes is of great help for future provision and prosperity of human beings only when it is based on process- and mechanism-understanding. In general it is difficult to understand long-term records appropriately on the basis of physical, chemical and biological processes because they are complex and lack of quantitative information available for mathematical models to be used for prediction. In this context lake-catchment systems are one of possible promising ones for providing long-term information with process-understanding. Studies on temporal changes in lake-catchment systems may make clear correlations between landscapes and environmental changes through sediment information and lake-catchment observation, both in short-term and long-term.

We (Darhad Drilling Project (DDP) group) have made some expedition and core-sampling in Darhad paleo-lake, northern Mongolia for clarifying long-term hydrological changes and geomorphic processes since 2009. Here we introduce the outline of the project and some preliminary results of long lacustrine sediments from the lake.

Keywords: lake-catchment system, lacustrine sediments

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HGM002-03

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Limno-geomorphological changes during Late Pleistocene and

A. Orkhonselenge^{1*}, Kenji Kashiwaya¹, Krivonogov.S², Toshio Nakamura³, Yamamoto.M¹, Mino.K¹

¹Kanazawa University, ²Institute of Geology and Mineralogy, RAS, ³Nagoya University

Limno-geomorphological changes during Late Pleistocene and Holocene in Inner Continental Asia

This study aims to reveal limno-geomorphological changes during Late Pleistocene and Holocene on the bases of the physical and chemical analyses of the lacustrine sediments obtained from Lake Khuvsgul in Mongolian Plateau and Lake Siling-co in Tibetan Plateau. Analytical results of the sedimentary sequence in Borsog Bay of Lake Khuvsgul shows certain environmental shifts at about and 4.0 kyr BP and 6.0 kyr BP; noticeable increases are detected in grain sizes, mineral content and grain density during the periods when the organic matter, biogenic silica and diatom abundance decreased. Bottom sediments in Lake Siling-co indicates comparatively large fluctuations in hydrological conditions at a water inflow for a short-term period at about 1.5 kyr B.P and 10.0 kyr B.P, when rapid coarsening and carbonating within lacustrine deposits occurred as a result in drops of lake level. Limno-geomorphological changes in the both lacustrine catchments imply a relation with large discharge of melting water from high mountains surrounding the lakes. Although, it shows the both plateaus are differently responsible to climatic changes during the Late Pleistocene and Holocene.

Keywords: Limno-geomorphology, Late Pleistocene, Holocene, Plateaus, Mongolia, Tibet

HGM002-04

Room:301A

Time:May 25 17:15-17:30

Quantitative analysis of lithologic and tectonic influences on the topographic profiles of Danxia landforms

wen zhang^{1*}, Takashi Oguchi², Yuichi S. Hayakawa²

¹Univ. Tokyo, ²CSIS, Univ. Tokyo

“Danxia landform” is a landform made up of non-marine red clastic rock and characterized by red walls and red cliff caused by long-term fluvial dissection. Mountains and hilly lands dissected by fluvial processes including Danxia can be characterized by stream longitudinal profiles and valley transverse profiles. Therefore, longitudinal and transverse profiles of Mt. Danxia in China have been extracted from DEMs, and a series of morphometric analyses were conducted to infer lithologic and tectonic influences on landforms. Mt. Danxia is the place where the term “Danxia landform” was coined. Its general topography has been affected by fractures caused by crustal movement. The area is underlain by two formations of sedimentary rocks: the Changba Formation and the Danxia Formation.

The extracted longitudinal profiles for 45 river basins were analyzed using the stream length gradient index (SL index), the slope-area relationship and the concavity index. Abnormally high SL values occur where a river crosses a fault or rock resistance changes significantly. The slope-area relationship often exhibits a pronounced break related to the spatial scale of the drainage basin. The concavity index tends to increase from the western area of the Jinjiang river basin, underlain mainly by the Changba Formation, to the eastern area underlain mainly by the Danxia Formation. The index is relatively high in the center of Mt. Danxia. The morphometric characteristics of the transverse profiles were also examined in relation to lithology and tectonics. The results provide one of the first quantitative geomorphological evaluations of Danxia landforms.

Keywords: Danxia landforms, SL index, Longitudinal and transverse profiles, DEM

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HGM002-05

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Fault-scarp knickpoint recession and subsequent riverbank widening in central Taiwan

Yuichi S. Hayakawa^{1*}

¹The University of Tokyo

Along the Chelungpu thrust fault in central Taiwan whose surface rupture emerged by the 921 Chi-Chi Earthquake on September 21, 1999, knickpoints were formed in the rivers crossing the fault and some of them have continued to recede upstream by fluvial erosion. The rates of recession of these knickpoints have been extremely high as noted in our previous reports. Also, as the knickpoints recede very quickly, inner channels were formed downstream of such knickpoints with a depth of several meters. The inner channels seem to expand their width after the passing of the knickpoints. Here the temporal changes in the morphology of the bedrock rivers around the fault scarp are examined by means of field topographic measurement and satellite imagery investigations. The rates of the knickpoint recession vary through the time; for instance, the knickpoint in the Ta-chia River shows recession rate 3.3 m/y in the earlier 6 years (1999-2005) and 220 m/y in the last 4 years (2005-2009). Such variations in the recession rates could be mainly caused by the variations in flood intensity and frequency and artificial modifications, rather than the bedrock strength variability.

Keywords: knickpoint, bedrock erosion, field measurement, satellite imagery

HGM002-06

Room:301A

Time:May 25 17:45-18:00

Block deposits in Japan and Korea

Masayuki Seto^{1*}, Yukiya TANAKA², Hiroshi SHIMAZU³

¹Saitama University, ²Kyung Hee University, ³Rissho University

This study examined aspects of slope processes corresponding to climatic changes on low altitude mountain slopes based on geomorphic and stratigraphic investigation of slope deposits. Using the name "block deposition feature" which has no implication of particular formation processes for so-called block streams. There are many block deposition features and block fields in Japan and Korea. This study analyzed the morphological characteristics of a block deposition feature near Mt. Yokone on Kobugahara Plateau in the northern part of the Ashio mountains, composed of granodiorite. New findings are concerning the age and the formative processes of slope deposits on the Kobugahara plateau, northern part of the Ashio Mountains, which are composed of granodiorite with thick weathering crust. Many blocks which are originated from core stone distributed on the plateau. At Mt. Yokone in the Kobugahara, the block deposition feature is located in a valley head. A few streams spring out from the both sides of the block deposition feature, and seeps under the blocks. After detailed survey of longitudinal and cross sections and plan forms of the block deposition feature, the feature is divided into the three segments: A, B, and C. Segment A and C show narrow forms and thin block deposits, while segment B is wide with thick block deposits. There are some lobes on Segment B. Segment A and C are run-ways of blocks and segment B is a zone of block deposition. It is indicated that core stones moved on slopes. Since there are some lobes on Segment B, slow mass movement may have played a role in its formation. Superficial deposits of slopes consist of the gully-fill colluvium, the upper slope deposits, and the lower slope deposits. The upper slope deposits are composed of humic soil and silty-clay layers. The lower slope deposits include blocks, fragments of weathering rind, and pumice and scoria correlated to Ag-KP(45-50 ka) and Nt-I (14-15 ka), respectively. Blocks and fragments of Ag-KP are randomly scattered in brown silty matrix, while Nt-I fragments are contained in the upper part of the lower slope deposits. The gully-fill colluvium composed of silt-clay and blocks fill gullies excavated in the lower slope deposits. Block deposits which form block deposition feature also fill troughs excavated in the lower slope deposits. The above evidence indicates that the period of slope instability, which denotes the phase of active colluvium migration on slopes in changing environment, started around the fall of Ag-KP and ended before the Nt-I falling. After the period, block deposition features were formed. Facies and the mode of occurrence of the lower slope deposits suggest that they were formed with some kinds of slow mass-movement, which acted extensively on several geomorphic positions. Not only their facies but also their age do not exclude that these processes were active in periglacial environment. This conclusion contributes to reveal slope processes corresponding to climatic changes on low altitude mountain slopes.

Keywords: block stream, block deposition feature, block fields, slope processes, Korea, Ashio mountains

HGM002-07

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Analysis of hydrological deep-seated landslides triggering mechanisms in Mt. Wanitsuka, Kyushu Island.

Cristobal Padilla^{1*}, Yuichi Onda¹, Kenta Tanaka¹, Shinya Takahashi¹, Taro Uchida¹, Shigeaki Baba¹

¹University of Tsukuba

In September 6th of 2005 Kyushu Island was hit by the typhoon No 14 causing several damages and large slope collapses, such as deep seated landslides and debris flows. Some of them took place in Mt Wanitsuka, Miyazaki Prefecture. This study has the objective to analyze the hydrological conditions which trigger deep-seated landslides in Mt. Wanitsuka. For that purpose it had been controlled three small catchments in the vicinity of a deep seated landslide scarp which took place in 2005, from 2008 until the present. In those catchments it was installed parshall flumes and water samplers to control runoff O18/Deuterium isotopic concentration and ionic concentration. Additionally in the area it was installed 2 boreholes, 40 m and 10 m depth, to control the groundwater level and one pluviometer. The geology of the mountain is mainly shale interbedded sandstone highly fractured. According to previous studies based on analysis of effective rainfall and groundwater level, the effective rainfall with a half life of 84 hours show the best correlation with the lag time between the peak of rainfall and groundwater level peak (Tanaka, 2010). Using that correlation it was possible to estimate the timing of landslides event in 2 min after the rainfall peak. That agrees with the estimation time of landslides occurrence which is 30 min. after the rainfall peak. In other hand, Takahashi (2010) analyzing the Ca²⁺ concentration of streams water in the same study area demonstrated the high correlation between the sites where deep seated landslides deposit are located and the influence of deep ground water. The isotopic analysis of runoff shows a significant pulse of "old water" during the rising limb of the runoff hydrograph. That pulse was observed for precipitation with regular intensity (30 mm/hr as a peak) and accumulated rainfall of about 200 mm (in 20 hours). For the next rainfall events with similar intensity but smaller duration (smaller accumulated rainfall) the pulse of "old water" progressively reduced. This evidence suggests the importance of the accumulated rainfall in the hydrogeological response of the catchments in the study area and therefore it has an important role in the triggering of deep seated landslides over the high intensity rainfall. That agrees with the characteristics of the trigger precipitation of the landslides in 2005, with about 40 mm/hr as a peak intensity but 900 mm of accumulated rainfall at the estimated time of landslides occurrence. For that reasons it is suggested that the analysis of deep seated landslides triggering mechanisms must consider a variable, based on the accumulated rainfall as the effective rainfall, which indicated of the volume of water stored in the bedrock trough the time in order to estimate the critical volume to trigger deep seated landslides in the area.

Keywords: Mt. Wanitsuka, Deep-seated landslides, Landslides triggering mechanisms, Kyushu, 2005

HGM002-08

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Bedform distribution where the substratum is partly covered with sand: field observation and flume experiment

Keisuke Taniguchi^{1*}

¹Doshisha University

In the area where the substratum is partly covered with sand, the characteristic bedform distributions composed of dune trains surrounded by sand ribbons and sand patches are developed. I conducted the field observation and flume experiment on the distribution in order to investigate the forming processes and conditions.

Field observation in Kizu river: Unique bedforms in the area where there are insufficient sand to cover whole surface were observed in the field observation in Kizu river. Typhoon No.18 in 2009 gave a heavy rain to the south and central Kinki area, then the water level of Kizu river rose approximately 6 m. There were not only the barchan (lunate) and transverse dunes but also sand patches without a sharp crest line and sand ribbons lying parallel to the streamline on the athletic fields in the flood channel of Kizu river.

The distributions of the bedforms were also characteristic. These distributions had the same features as the block diagram on the distribution of bedforms formed by tidal flows on the seafloor (Belderson, 1982). For example, barchan dunes and sand ribbons existed adjacently, a sand patch field laid at the downstream side of a dune train, and sand patches composed of the coarser grains at the upstream side of a dune train.

Flume experiment: The same bedform distributions as the field observed were formed in the flume experiment. The flow velocity spatially varied in the range from 23 to 33 cm/s (at 5 mm above the bottom of flume) due to a gentle (1:100) slope on the bottom of the flume. The initial topography was a flat sand bed of 240 g weighted moderately-sorted very fine sand (0.11 mm in mean diameter, 0.72 in the standard deviation). The developing processes of the bedform distribution were recorded from the top of the flume.

In the first stage of the experimental run, dune trains developed at the upstream side. At the same time, the downstream part was covered with sand patches. While the dune train developed from the sand moving in traction, the sand patches were formed from suspended sand. The growth rate of the dunes was much lower than that of the sand patches.

The dune train migrated into the field covered with sand patches after formation of the dunes. This is because the dunes move to the downstream direction, although the sand patches hardly move. In the boundary area between two bedforms, a new crest line was formed on the sand patches. The spacing between the new crest and the existing crest at the downstream end of the dune trains was the same as the wave length in the dune train.

Reference: Belderson, R. H., Jonson, M. A. and Kenyon, N.H., 1982. Bedforms, pp.27-57. In: Stride, A.H. (Ed.), Offshore Tidal Sands Processes and Deposits. Chapman and Hall, London, New York, 222p.

Keywords: barchan, sand dune, sand patch, sand ribbon, distribution of bedforms, Kizu river

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HGM002-P01

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Landslide susceptibility mapping considering earthquake in west Nepal

Hiroshi, P. Sato^{1*}, HIROSHI YAGI²

¹GSI of Japan, ²Yamagata Univ

We used distribution data of 2005 north Pakistan (Kashmir) earthquake (M7.6)-induced landslides as the training data, and mapped earthquake-induced landslide susceptibility in study area of 27km by 27km in west Nepal using four causative factors: slope, convexity, pit-peak, and distance from active faults. For calculating the former three factors we used 30-m-resolution digital elevation model, and for calculating the distance, we dealt Main Boundary Fault as strike slip fault and Himalayan Frontal Fault as reverse fault in the study area. And for classifying the susceptibility we used the Information Value (InfoVal) method. As a result, four susceptibility classes, Very low (landslide area ratio, 0-1%, same as hereinafter), Low (1-3%), High (4-9%), and Very high (10-75%) are mapped; however, threshold decision according to the probability remains to be solved to keep objectivity.

Keywords: landslide, susceptibility, Nepal, earthquake, fault

HGM002-P02

Room:Convention Hall

Time:May 24 16:15-18:45

Geomorphic development in a basin fringe in West Java and its effect on agro-landscape differentiation

Toshikazu Tamura^{1*}, Satoru Okubo², Koji Harashina³, Chay Asdak⁴, Kazuhiko Takeuchi⁵

¹Geo-environmental Science, Rissho Univ., ²Univ. Tokyo, ³Iwate Univ., ⁴Padjadjaran Univ., ⁵Univ. Tokyo

A kind of elaborate traditional agricultural land-use, which is appreciated as sustainable resources management in humid-tropical environment, co-exists with some other types of land-use in a limited area of West Java. Although the land-use has been decided in compound socio-economic and/or cultural contexts, some physical environmental factors must be involved in. This report intends to clarify the spatial relation between geomorphic condition and present agricultural landscape.

The Bandung Basin situated in the western part of Java is a tectonic depression dammed-up repeatedly by volcanic products from the north. The south of the basin is fringed by low hills composed principally of Neogene volcanic and pyroclastic rocks and old Quaternary volcanic edifices behind. A south to north transection passing the southwestern margin of the basin is divided into the following three geomorphic zones which are further subdivided:

I Old volcano (Bubut Volcano): Ia Old volcano summit, Ib Old volcano flank

II Hills (Rampadan-Sadu Hills): IIa Higher hill zone, IIb Lower hill zone

III Alluvial fan (Karamatmulya Fan)

More precisely in topographic scale, the following geomorphic units are recognizable:

T (Hilltop gentle slope), A (Accordant ridge), M (Monoclinical ridge), I (Isolated hillock), C (Scarpland), S (Saucer-shaped trough), G (Gorge), B (arrow valley bottom), F (Small alluvial fan).

Any geomorphic zone or subzone is characterized by particular assemblage of topographic-scale geomorphic units. Morphometric characteristics of each geomorphic zone or subzone illustrate the contrast between coarse and fine topographic texture in the Old Volcano (Zone I) and the Hills (Zone II). Although the contrast does not simply correspond to geology, some locational differences in lithology control the occurrence of surface and subsurface water, and then they influenced the dissection pattern.

Erosional development of landforms in the Zone IIa was followed by the base-level lowering which resulted in the appearance of the Zone IIb. New accretion of volcano, the Zone I, probably in the Mid-Pleistocene, provided the rearrangement of drainage systems which connect the old system in the Zone II to the newly appeared one by which the volcano was dissected. Since the Latest Pleistocene or early Holocene, adaptation to the new base-level, i.e., that of the Zone III, has been on going.

The most impressive difference in agricultural landscape in the area is the concentration of mixed bamboo-tree gardens in Geomorphic Subzone IIb in contrast to the dominance of open upland fields in Subzones Ia and Ib. Subzone IIa shows an intermediate or transitional situation. The most apparent difference in geomorphic condition among the subzones is not relief energy but topographic texture. The difference in topographic texture among the subzones is the result of geomorphic history as summarized above. The difference, which is considered to provide the difference in arability, particularly the capacity of extensive forest clearance, and in accessibility to and applicability of water resources, is evaluated by local farmers in their decision of land-use. The result is the contrastive agricultural landscape.

Keywords: Tropics, Hills, Old volcano, Geomorphic development, Agricultural landscape, Java

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HGM002-P03

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Knickpoints in Shihmen Reservoir Watershed

Ching-Ying Tsou^{1*}, Masahiro Chigira¹, Yuki Matsushi¹, Su-Chin Chen²

¹DPRI, Kyoto University, ²SWC, National Chung Hsing University

The Shihmen reservoir watershed, northern Taiwan, has many knickpoints, which could be interpreted as a response of river incision against base-level lowering probably by uplift. The drainage network of Shihmen reservoir watershed is framed by trunk Dahan River, its three major tributaries and many minor tributaries. The knickpoints are identified from longitudinal profiles by using a 12-m DEM. A strong power-law relation is presented between drainage area above a knickpoint and distance from drainage divide to a knickpoint. There is a poor power-law relation between drainage area above a knickpoint and elevation of a knickpoint. Major tributaries have four or five major knickpoints each, and one knickpoint along one major tributary can be correlated to a knickpoint along another major tributary. This is indicative that landscapes respond to base level lowering via upstream propagation of knickpoints. Most selected third-to first-order minor tributaries display prominent steep reach at the confluences with trunk or major tributaries with relative height of several tens to a few hundred meters. The minor tributaries of the major tributaries also have knickpoints, which are frequent on higher-order streams and could be correlated to each other and to the knickpoints along the major tributaries. This does indicate that knickpoints in these tributary basins are the result of multiple episodes of base-level lowering on Dahan River.

Keywords: knickpoints, river incision

HGM002-P04

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Transport processes of huge debris in Japanese mountain river basins

Hiroshi Shimazu^{1*}

¹Rissho University

Some of the Japanese mountain river basins have huge debris, sometimes larger than 10m, on their riverbeds. This study aims to discuss transport processes of huge debris. The investigated river basins are the Tadori River in central Japan and the rivers on the Yaku Island in southern Japan. The diameter of such huge debris was measured in the field and the channel slope was derived using 1:25,000 topographic maps. Further geomorphological investigations were performed in the field and using air photo interpretations.

The Tadori River is a 70km-long river that originates in the Hakusan volcano (2,702m a.s.l.). Its drainage basin was affected by heavy rainfall in July 1934. Snow-melt water and heavy rain caused severe flooding along the whole river course and many landslides in the headwater region. The valley of the upper reaches was buried about 20m deep. After the flood, much huge debris was seen on the riverbed. The largest one was 20m in diameter. It was named "Hyakumangan-iwa", which means a rock of about 4,000 tons in weight. The debris was carried from the upper tributary basin, because the geology of the basin is the same as that of the debris. A landslide with huge debris and small lacustrine-like deposits in the valley floor was found in this basin by field survey. This means that huge debris, including the Hyakumangan-iwa, was transported by the torrential flood as a small landslide dam gave way. During the event many landslide dams would form and break up, so that large amounts of debris ran down and buried the valley floor.

Many rivers on the Yaku Island, one of the UNESCO World Heritage Sites, also have huge debris on their riverbeds. Sometimes debris is as large as 10m in diameter. Detailed field survey carried out along the Miyanoura River has shown that the maximum diameter of the debris decrease downstream according to decrease in channel slope declivity. Huge debris as large as several meters in diameter, was also found on the riverbed with a 5% channel slope declivity. It means that the huge debris is transported downstream by the flood under a sorting process. Based on air photo interpretation, huge debris, found at the junction of the mainstream with its tributary, jams the valley floor of the main stream. This shows that huge debris produced in a tributary blocked up the valley floor of the mainstream forming a dam-lake. When the debris dam gave way, torrential flood occurred and huge debris was washed away. Because the debris underwent a sorting process, only smaller debris was transported to the lower reaches with gentler channel slope.

Formation and breakage of debris dams caused by landslides and/or debris supply from tributaries is very important for debris transport in the Japanese mountain river basins.

Keywords: debris transport process, torrential flood, mountain river, debris dam, Japan

HGM002-P05

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Influence of rock properties on salt weathering of natural and reconstituted stones: An experimental approach

Toshiaki Fujimaki^{1*}, Yuko Osawa², Chiaki T. Oguchi³, Celine SCHNEIDER⁴

¹Saitama university, ²Saitama University, ³GRIS, saitama University, ⁴GEGENA Universite de Reims Champagne-Ard

To investigate the influence of properties of rocks used in buildings, salt weathering experiments were performed using five building stones used in Europe and Japan. They are; (1) the Bajocian limestone (BL) with abundant well-preserved calcite shells and (2) the Sinemurian limestone (SL), rich in quartz grains, (3) reconstituted stones (RS), agglutinated using cement with crushed above two types of limestones, (4) Savonniere limestone (SV), porous and biogenetic limestone widely used in north France, and (5) Oya tuff (OY), altered rhyolitic tuff and one of the most famous stone resources in Japan. The BL, SL and RS stones are used in the Orval Abbey in south Belgium, and SV is used as a restoration stone of the Reim Cathedral in France. Their rock properties as a starting material such as porosity, bulk density, pore size distribution and tensile strength are investigated. The porosity of these stones are; RS 29.0%, SL 12.9%, BL 34.8%, SV 40.0% and OY 38.9%. The tensile strength are; RS 3.05 MPa, SL 4.82 MPa, BL 1.38 MP, SV 1.41 MPa and OY 1.85 MPa. The specimens are cut into cylindrical with a size of 4.5 cm in diameter and 5 cm in height. A capillary rise experiment was performed under 20 degree C atmosphere using saturated Na₂SO₄ solution at 20 degree C (16% Na₂SO₄ solution), half concentration of it (8% Na₂SO₄ solution) and distilled water as a control.

The results showed that BL had the fastest rates of capillary rise under 16% Na₂SO₄ solution and SL, RS, SV and OY follow in this order. Under 8% Na₂SO₄ solution, the faster rates of capillary rates recorded BL, RS, SV, OR and SL in this order. After the capillary test, only RS was completely destroyed, although it has much higher tensile strength than BL and SV. Small amount of debris was produced from the top edge of OY specimen.

Keywords: Salt Wethering, Limestone, Oya Tuff, Rock Property