

## Relationship between growth of active fold and slope collapse in Chuetsu District, Niigata Prefecture

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This study compared the relationship between growth of active fold accompanied by an earthquake and concentration of slope collapse about the case of the Yamakoshi area in the 2004 Niigata Prefecture Chuetsu Earthquake and the Nishiyama hills in the 2007 Niigata Prefecture Chuetsu-oki Earthquake. Koarai et al. (2011a, 2011b) have reported the result of this research in the first year.

The result of terrace classification in the area along Imokawa River interpreted from the 1-m interval contour lines by airborne laser survey data is shown in Fig. 1. The terrace was divided into eight steps, and terrace 5 is not covered with loam, but terrace 3 is covered with loam which contains bubble wall type volcanic glass and ortho-pyroxene. This tephra is not identified with known tephra. While UG tephra which regarded as having descended about 12,000 years ago is detected on terrace 1 (equivalent to terrace Lf1 by Hataya et al. (2006)), K-Ah tephra which descended about 7,000 years ago is detected and the tephra before UG is not detected on terrace 3. Thus, it is considered that terrace 3 was formed between 12,000 years ago and 7,000 year ago.

On the other hand, the volcanic glass which can be identified as UG was detected in the layer on terrace Lf4 along Uono River with chemical composition analysis. The existence of As-K tephra which descended about 15,000 years ago in this layer was reported by Hataya et al. (2006). The formed age of the terrace along Uono River has the possibility to be younger than before.

Displacement between present river bed and terrace 3 is about 30 m in the upstream area of the Imokawa River (near the axis of Komatsukura anticline), and is about 20 m in the downstream area of the river (near the Uono River juncture), with horizontal distance of 750 m. It is assumed that the difference of the displacement is brought by the growth of Komatsukura anticline. Based on Koarai (1990), it is considered as the growth rate of active fold is supposed to be equivalent to: (vertical displacement / horizontal distance) / terrace formation age. The growth rate of Komatsukura anticline might be calculated as: (vertical displacement of terrace 3 / horizontal distance) / formation age of terrace 3 = (10m / 750m) / 7,000-12,000yr = 1.1-1.9\*10<sup>-6</sup>/year. According to Koarai et al. (2010), the growth rate of active fold is 8.3\*10<sup>-7</sup>/year in the Nishiyama Hills, and 4.5-5.3\*10<sup>-7</sup>/year at Yamamotoyama terrace (covered with Iz-Kt), 1.0-1.2\*10<sup>-7</sup>/year at Kowadahara terrace (covered with Aso-4), 1.0\*10<sup>-6</sup>/year at Ikenaka-shinden terrace (covered with DKP), and 1.1\*10<sup>-6</sup>/year at Ojiya terrace (covered with AS-K) in the Ojiya area. The growth rate of active fold (Komatsukura anticline) near Imokawa River region is corresponded to the Nishiyama hills or the Ojiya area in order level.

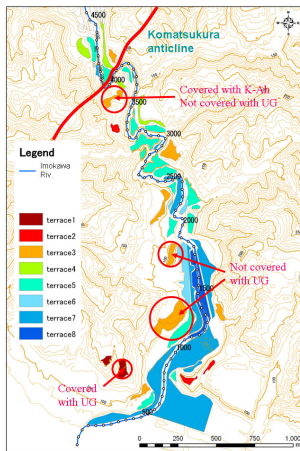
In the case of the 2011 Nagano and Niigata border Earthquake, slope collapse was concentrated on Matsunoyama area which is located on the hanging wall side of a reversed fault and crustal deformation was detected by InSAR in this area (Nakano et al.2012).The phenomenon that slope collapse by an earthquake is concentrated on the upheaval region was also observed by the 2004 Niigata Prefecture Chuetsu Earthquake and the 2007 Niigata prefecture Chuetsu-oki Earthquake. Since Matsunoyama anticline existed in Matsunoyama area, slope collapses may have occurred in the growth region of active fold accompanied by an earthquake.

Keywords: active fold, slope collapse, Chuetsu District, Imokawa River basin, growth speed, UG tephra

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## Magnetostratigraphy of the sediment cores derived from the Setagaya and Fuchu areas of Tokyo Metropolitan, central Japan

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Three sediment cores were derived from the Setagaya and Fuchu areas of Tokyo Metropolitan, southern Kanto Plain, central Japan. The NUCHS-1 core drilled in the Setagaya area of Nihon University is composed of terrace deposits, peat and tephric loess up to -12.7 m, and marine sand and gravels of the early Pleistocene Kazusa Group from -12.7 to 80.0 m. The Cobb Mountain Subchron was found in the NUCHS-1 core from -12.7 to -24.5 m. The TAT-1 and TAT-2 cores drilled in the Fuchu area of Tokyo University of Agriculture and Technology. The TAT-1 and TAT-2 cores are composed of terrace deposits and tephric loess up to -11.5 m and 8.9 m, and marine silt sand and gravels of the early Pleistocene Kazusa Group from -11.5 m and 8.9 m to 50.0 m. The Olduvai Subchron was found in the TAT-1 and TAT-2 cores from -11.5 to -16.3 m and -8.9 to 23.0 m.

Keywords: Kanto Plain, Magnetostratigraphy, Early Pleistocene, Sediment core, Kazusa Group

## Sedimentary facies and physical properties of the Kazusa Group cores from Setagaya and Fuchu area Tokyo, Japan

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The Pliocene to Middle Pleistocene Kazusa Group is widely distributed in the Kanto Plain, central Japan. In this study, we obtained three cores from the late Pleistocene terraces called Musashino uplands in the southwestern part of the Kanto Plain. These cores consist of the Kazusa Group sediments, terrace gravels, and volcanic ashes and surface soils called Kanto Loam, in ascending order. We logged the lithology and sedimentary structures of these cores in detail. Grain-size distributions, water content, density of soil particles, electrical conductivity and pH values in soil-stirred water were measured. Also, diatom assemblage analysis and X-ray fluorescence analysis were conducted.

The 80-m-long CRE-NUCHS-1 core was obtained from Setagaya district, Tokyo (altitude: 41m), which is located on the Shimosueyoshi surface of the Musashino uplands. It consists of the bluish gray sand of Kazusa Group, terrace gravels, and Kanto Loam in ascending order. The sand of the Kazusa Group indicates upward coarsening trend with abundant pumice and plant fragments. The sulfur value and electric conductivity are high in upper part. The lower part of the sand (below 45m in depth) contains the shell fragments with high calcium content and pH values.

CRE-TAT-1 core (altitude: 56.06m, penetration depth: 50m), and CRE-TAT-2 core (altitude: 59.14m, penetration depth: 55m) were drilled in the Fuchu city, Tokyo, which is on the Tachikawa surface of the Musashino uplands. They are divided into unit 1 to unit 7 units in ascending order. Unit 2, 4, and 6 are gravels. Unit 1 is sandy channel sediments and floodplain sediments. Unit 3 consists of silt with brackish-water diatom. The lower part of the Unit 5 is bluish gray silt with abundant marine diatom. Since the sulfur content and electric conductivity is high, this part should be the marine sediments. It gradually changes into the sandy channel and floodplain sediments. Geomagnetic polarities change from normal to reverse in unit 5 (Ueki et al., this volume). Thus, unit 1 to 5 should be the Kazusa Group sediments. Unit 6 and unit 7 are terrace gravels and Kanto Loam, respectively.

### Acknowledgement

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Keywords: Kazusa formation

## Human-environment interactions and a framework of prehistoric anthropography

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Present paper discusses how the reconstructed human society from archaeological records should be integrated and named when we understand the human-environment interactions. Prehistoric human society that has reconstructed from various Quaternary disciplines is only possible to evaluate from fragmental excavated data. There are two feedback reference methods from present to the prehistoric past. First is experimental archaeology, and the second is ethnographic archeology; and both are called as middle range research in archaeology. The latter method based exclusively on behavioral patterns of present ethnographic evidence. As a matter of fact, the reconstructed prehistoric world is not a concrete ethnography and /or ethos, it should be emphasized that a neutral term anthropography will be more adequate when discusses the prehistoric objects. The ongoing project, Historical variation in interactions between humans and natural resources: towards the construction of a prehistoric anthropography, (project leader: A. Ono ) will be introduced in this connection, and the conceptual framework of prehistoric anthropography is also discussed.

Keywords: prehistory, anthropography, middle-range reserach, ethnographic archeology, human-environment interactions, archaeology

## Radiocarbon dates of the Early Upper Palaeolithic and Environmental History during the MIS 3 in the Palaeo-Honshu Island

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Relationships between human activities and environmental changes have become an important research topic in the Japanese Palaeolithic archaeology. This presentation focuses on this topic with particular reference to the temporal correlation among climatic and archaeological records during the Marine Isotope Stage (MIS) 3 in the Palaeo-Honshu Island.

To show the general outline of the environmental history of the MIS 3 and MIS 2, climate history has been roughly divided into seven phases:

MIS 3 Stable Warm (ca. 60,000-44,000 cal BP)

MIS 3 Transition (ca. 44,000-38,000 cal BP)

MIS 3 Early Cold (ca. 38,000-28,000 cal BP)

MIS 2 LGM Cold-1 (ca. 28,000-24,000 cal BP)

MIS 2 LGM Cold-2 (ca. 24,000-15,000 cal BP)

MIS 2 LG Warm (ca. 15,000-13,000 cal BP)

MIS-2 LG Cold (ca. 13,000-11,500 cal BP)

Archaeological sites of the Early Upper Palaeolithic have been correlated with these climate phases, using calibrated radiocarbon dates by Intcal09.

### **MIS 3 Stable Warm and Transition (ca. 60,000-38,000 cal BP)**

These phases are placed early half of the MIS 3 in which relatively warm climate condition had been dominated in the Last Glacial. Around the Lake Nojiri at the central Honshu, fossil bones of the megafauna at the Tategahana site have been placed ca. 53,000-37,000 cal BP. Tategahana was interpreted as a kill and butchery site, however, the presence of the big game hunters is still uncertain. We have no reliable archaeological evidence of the Early or Middle Palaeolithic period (before 37,000 cal BP) in the Japanese archipelago.

### **MIS 3 Early Cold (ca. 38,000-28,000 cal BP)**

The earliest human occupations in the Palaeo-Honshu Island were characterized by trapezoid tools, blade tools, edge-ground stone tools, and circular settlements are found in Tachikawa Loam layer X and IX, at ca. 37,000-34,000 cal BP. Compiled radiocarbon dates of the Early Upper Palaeolithic sites were concentrated on ca. 37,000-30,000 cal BP, and they were almost coincided with the Early Cold phase (ca. 38,000-28,000 cal BP). The number of Palaeolithic sites increased suddenly after 37,000 cal BP. This event seems to coincide with the timing of the migration of Homo sapiens into the Japanese archipelago as many archaeologists pointed out.

The temporal placement of the lithic industry from Tachikawa Loam layer VII and VI, characterized by blade tools especially standardized backed blades, seem to be placed at 33,000-29,000 cal BP. It coincides with the second half of the Early Cold, however, climate had already become cold and dry condition same as the LGM Cold phase (28,000-24,000 cal BP).

## Exploitation of obsidian sources in the Central Highlands and the earliest obsidian use

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A number of Upper Palaeolithic (UP) and Jomon occupation sites remain in an obsidian source area of Kirigamine and Yatsugatake, Nagano Prefecture. The site distribution pattern attributed to both periods is in stark contrast in the area. While the UP sites tend to be concentrated in a high altitudinal zone above 1500 m particularly close to the sources, the Jomon sites tend to be distributed in hillslopes apart from sources in a lower altitudinal zone below 1500 m. This fact reflects historical changes of procurement technologies, landscape use, organization of groups, and the circulation systems. Obsidian from the Central Highlands is a non-local lithic raw material transported and distributed extensively in central Japan. Here, non-local means that transportation of lithic raw material is more than 80 km to a residential area.

**PROCUREMENT TECHNOLOGY:** obsidian used in the UP is collected from the ground surface of either outcrops or other procuring spots. No evidence asserting the existence of mining activities of the UP has been found. The earliest use of obsidian from the Central Highlands dates back to ca. 38 ka cal yr BP. In contrast, large-sized Jomon mining sites in which underground obsidian nodules were dug out from numerous pits have been discovered. The existence of digging technology features in Jomon procurement activities. The earliest mining pit dates back to the late phase of the incipient Jomon.

**LANDSCAPE USE:** UP obsidian procurement tended to be connected with primary nodule processing, stone tool production, and short-term encampment probably with hunting activities. In addition, large-sized lithic workshops adjacent to the sources occurred as a result of the recurrent landscape use. This is the reason why concentrated distribution of the UP occupations occurred in places close to the sources. While primary processing of obsidian took place in the vicinity of mining pits by the time of the incipient Jomon, subsequent mining activities were not associated with lithic workshops. No semi-sedentary Jomon settlement, except small-sized temporary sites have been discovered above 1500 m. Specialization in mining and carrying out unprocessed obsidian nodules, and rarity of other subsistence activities close to the sources are features of the Jomon obsidian procurement.

**ORGANIZATION AND CIRCULATION SYSTEM:** three types of procurement patterns are recognized in the UP. First, the procurement is originally embedded in an extensive territory of local groups. Second, small parties dispatched by a local group obtain and transport obsidian. Third, a local group near the source area supplies obsidian to the other local groups. The first and the second patterns had occurred since the Early Upper Palaeolithic (38 - 28 ka cal yr BP), and the third one emerged in the Late Upper Palaeolithic (28 - 16 ka cal yr BP). For the Jomon obsidian mining, the existence of specialized task groups which engaged in mining activity is assumed. Jomon pottery and hearth features packed between layers of abandoned soil resulted from digging indicate the existence of encampment matched the period of work. The Jomon settlements and the mines are completely distinguished from each other. A large amount of obsidian artifacts, and obsidian storage often found from the former sites located in the zone below 1500 m show them to be relay stations for obsidian circulation. The tendency for specific obsidian from a given source to be transported and distributed in a specific consumption area and time reflects either the emergence of a local group which controlled the obsidian circulation, or of highly sophisticated social relations among the local groups, or both.

The oral presentation also refers to the earliest obsidian use of the UP peoples in the Kanto Plain, and its relationship with the dispersal of modern humans into the Japanese Archipelago.

Keywords: The Upper Palaeolithic, The Jomon Period, Natural resource exploitation, Obsidian, Jomon mining

## Drastic environmental changes recorded in the core deposits of Balkhash Lake, Kazakhstan

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To reconstruct environmental evolution in Ili Delta and Balkhash Lake areas, Kazakhstan, we have continued geological, geomorphological and paleoenvironmental researches under the Ili project, RIHN, since 2007(Endo et al.,2010). Following the results of lake level change in the last 2000 years using 2007 core in the western part of Balkhash Lake, we took several cores in 2009 in the easternmost part of the lake, where is the deepest part of the lake. These 2009 cores cover almost Holocene, and have been analyzed using pollen, diatom, and ostracod, and also geochemical and magnetic properties. These provide us continuous environmental records, which are combined with geological and geomorphological evidences in the land survey along Lepsi and Ili rivers to discuss the environmental evolution especially in mid Holocene in central Eurasia.

Location of two cores, 0901 and 0902, is in the easternmost part of Balkhash Lake, in the deepest part of the lake, about 20 m in depth. Cores are 5.67 m and 5.80 m in length, composed of whitish, massive clayey horizons, and blackish to brownish laminated silt/clay, partly sandy layers.

Both cores can be divided into three main sedimentary units of A, upper, B, middle and C, lower. In the core 0901, the unit A of 0-1.1 m and unit C of 4.0-5.6 m consist of massive whitish clayey sediments, and the unit B of 1.1-4.0 m is the alternations of finely-laminated sediments including sandy layer from 2.6 to 3.0 m. In the core of 0902, three units show the same character as 0901 core but the thickness is a little different, the unit A of 0-2.1 m, the unit B of 2.1-4.85 m, the unit C of 4.85-5.8 m. Both units A and C show high Ca, while unit B relatively low Ca, high Fe and Si. Especially in 0902 core, fine gypsum crystals are rich in the 3.55-3.68 horizon of the unit B, probably suggesting rapid desiccation of the lake floor. In this case, the lake level must be 20 meters lower than the present level.

The unit B of the cores is characterized by special lithology, frequent changes in diatom and ostracods, arid land vegetation like desert, decreased pollen from coniferous forest, suggesting dominance in highly lowered lake level, and warm and dry climate. It ranges from 6000-5500 to 3500 years ago, corresponds to the mid Holocene hyper arid stage, recently recognized in various regions.

Keywords: Balkhash Lake, lake level change, Central Eurasia



## Holocene synchronous fluctuations of the river beds flowing into Balkhash Lake and their relation to climate change

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Sedimentology and geomorphology team of Ili project organized by Research Institute for Humanity and Nature has reported Balkhash Lake level changes (e.g., Endo et al, 2009; Chiba et al, 2010, Sugai et al, 2010) and fluvial geomorphology of the rivers running into Balkhash Lake (e.g., Shimizu et al, 2010; Sugai et al, 2010; Kondo et al, 2011) based on field survey and integrated sediment analyses. This paper reports Holocene riverbed fluctuations of the Kurty River, a tributary of Ili River, and correlates with those of other rivers flowing into Balkhash Lake. Then, it discusses climate control on riverbed fluctuations along with the Balkhash Lake level changes. Holocene terrace levels along Kurty River can be classified into three of KH 1, 2 and 3 whose relative altitude to the present riverbed are about 6-7, 4-5, and 2 m, respectively. KH 1 was formed during early to middle Holocene (before ca. 5 ka: stage 1), while KH 2 and 3 late Holocene (from ca.2 ka to LIA: stage 3). Between ca. 5 ka and ca. 2 ka (stage 2), fluvial processes became inactive and aeolian processes were dominant.

KH 1, 2 and 3 can be correlated with LRT 2a, 2b and 3 terrace levels formed by Lepsy River, respectively. Both stages 1 and 3 can be correlated with the periods of high water level of Balkhash Lake, while stage 2 with low water level. In between the late 13th c and early 15th c of stage 3 peat or peaty silt deposited in wide areas inc. Kurty River valley, paleo Ili river channel system preserved on Bakanas delta, and Lepsy River valley, while Balkhash Lake level recorded highest during the last 2 ka. These suggest cold and wet climate conditions appeared in wide areas, central Asia. This probably reflects the increase of precipitation supplied from North Atlantic Ocean by the westerlies under negative NAO phase.

Endo et al,2009; Shimizu and Sugai, 2010; Sugai et al,2010;Chiba et al,2010: Project report on an Oasis-region vols.,7 and 8/ Endo et al,2011,Shimizu et al,2011: abstracts JpGU 2011 meeting/ Sugai et al, 2010; Kondo et al,2011: abstracts, Japan association for Quaternary research scientific meeting

Keywords: Ili river, central Asia, fluvial terrace, Holocene, climate change, chronology

## Numerical evaluation of human impacts on hydrological cycle of Ili-Balkhash basin

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The Ili River Basin is stretching over the China and Kazakhstan. It is an internal river that flows into the Balkhash Lake, which is the largest lake in the Central Asia. Its significant discharge comes from the Tian Shan ridge. Thus, elevation and precipitation difference in the basin is very large. Especially, from the middle part of the river to the lower part of the river, precipitation amount is drastically decreased, and there are classified as semi-arid and arid zone. While traditional living form of this region was combination of nomadic grazing and agriculture, there were large-scale developments such as electric power development by a dam construction and agricultural development during the period of the Soviet Union. In addition, under the condition of global warming, the amount of water supplied by glacier melting in the Tian Shan Mountain might decrease. Thus, to evaluate these anthropogenic impacts on hydrological cycle of the basin, we constructed a hydrological model.

The model consists of several modules to simulate hydrological processes. While spatial resolution of river routing is 0.5 degree, runoff calculation is executed with 1km spatial resolution. Time resolution is 1day. Number of tuning parameters is designed to be minimum as possible as we can. Without considering any anthropogenic impacts, simulated results could not follow the actual water level change of the Balkhash Lake after 1980. Thus, to clarify what kind of human impacts is the most significant one, we attempted to consider irrigation to agricultural lands, evaporation from the Kapchagai reservoir and outflow from melted glacier. As a result, we found that irrigation and evaporation from the Kapchagai reservoir are the two important factors which have a significant impact on water level changes of the Balkhash Lake.

Keywords: Ili River, irrigation, Kapchagai reservoir, Balkhash Lake

## The history of soil erosion in the Chinese Loess Plateau

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With regard to the history of soil erosion in the Chinese Loess Plateau, historians and historical geographers have hypothesized that the anthropogenic destruction of vegetation accelerated soil erosion and increased the flood frequency in the North China Plain. In order to demonstrate this hypothesis, geologists or physical geographers have accumulated related data. However, the specific effect of human activities and climate change on soil erosion is still unclear. Therefore, this paper proposes to introduce landform division and to conduct case studies in each geomorphic region for solving the abovementioned problem. Further, the necessity of study on the historical development of landforms is emphasized since it is the basis of landform division. As a case study, this paper conducts temporal comparison between two satellite imageries on the Chinese Loess Plateau.

Keywords: history, soil erosion, Loess Plateau, remote sensing, geographical information system

## The buried river valley found at Lake Tonle Sap, Cambodia

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Lake Tonle Sap is a huge lake located in the central part of Cambodia. The lake is known to drastically shrink and swell in an annual cycle. In dry periods the lake is less than 1-m deep, whereas the water depth exceeds 10 m in rainy periods. The latter phenomenon is caused by a water pulse supplied from the lower Mekong River. For this, Lake Tonle Sap serves a natural flood control for the Mekong delta, preventing floods, although the precise function and its historical change are still unclear.

Although previous studies presented the environmental history and geological structure for a limited small area of the lake, investigations for the wider area are expected to better understand the seasonal behavior and its role in the Southeast Asia. For this, we undertook a seismic survey three times covering the whole area of the lake using an echo-sounding device (Strata Box by Synquest Inc.). The total distance of the survey reached up to 300 km.

The seismic data for Lake Tonle Sap showed that the lake bottom is quite flat and the strong sonic reflectance was spatially observed at 1 to 2 m under the lake bottom surface. This suggests that thin mud layer is deposited up to the depth. On the other hand, the pattern of the sonic reflectance showed an lvalley-shapd configuration at several measuring lines. This valley could be a remnant of old streams having the depth ranging from 10 to 14 m and the width from several hundred meters to several kilometers. We reconstructed the distribution pattern of the paleo-Tonle Sap Rivers by spatially connecting the buried rivers.

We collected the sediment core at the deepest part of the Pale Tonle Sap River, and a series of lab measurements were undertaken, e.g., <sup>14</sup>C dating, paleomagnetism, and physical properties. These will be shown in the other paper during the conference.

Keywords: Lake Tonle Sap, buried river valley

## Chronology by <sup>14</sup>C analyses of wood circles excavated at the Mawaki site facing on Toyama Bay, in Noto Peninsula

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The Mawaki archaeological site, one of the biggest archaeological sites in central Japan, is located on the alluvial coastal plain facing to the Toyama bay at Noto peninsula, Central Japan. Excavation surveys at the site revealed that the site had been continuously occupied from the Early to Final Jomon periods (ca. 5200 cal BC - 500 cal BC). In the final stage of the site, wooden circular structures, peculiar to this region, were constructed. At the Mawaki site, totally 31 wooden poles have been excavated. The circular structures were discovered for the first time during the excavation in 1982-83, and confirmed explicitly in 2002-04. According to the archaeological studies, the combinations of 6-10 poles among these 31 wooden poles formed 6 independent circular structures (designated as Circles A to F). All wooden poles are chestnut trees, being cut in half vertically and possessing no bark. The biggest pole belonging to Circle A is about 1 m in diameter, and 10 poles were used to make up the Circle A. Each pole was set up in a pit of about 10-70 cm in depth from the ground surface. Diameter of the circles is about 5-7m, and circles A and B have a gate-like structure. The six structures overlapped each other at limited areas indicating that these structures had been rebuilt five times consecutively. Among the archaeological sites well-known for the wooden circular structures, the Mawaki site has the most typical structures and the wooden poles were well preserved against weathering. Therefore, the circular structures at the Mawaki site are suitable for chronological studies.

The <sup>14</sup>C wiggle-matching technique normally uses <sup>14</sup>C ages of several annual rings from the same wood. The radiocarbon community has developed internationally accepted data sets that describe the relation between <sup>14</sup>C ages and tree-ring ages (IntCal09). The <sup>14</sup>C ages of successive rings of sample wood are compared with those of the IntCal09 calibration data set by shifting the annual-ring number on the calibrated-age axis. Then the most probable calendar date is obtained for the outermost ring of the sample wood by using all the <sup>14</sup>C ages measured for annual rings.

This analysis was applied to wood samples, belonging to individual sets of wooden circular structures excavated at the Mawaki site, to estimate calendar age values of their outer-most rings accurately, and the formation age of each structure was estimated. For Circle A, 4 wooden poles and one wooden plate were analyzed and it was concluded that calendar age of its construction was about 820-770 cal BC. Also, the analysis was conducted for 2 wood poles belonging both Circles D and E, for one wood pole belonging definitely to Circle E, 2 wood poles belonging to Circle F. However, clear results were not obtained, because of the flat <sup>14</sup>C age structure against calendar age on this age periods in the IntCal09 calibration dataset. Calendar ages assigned briefly for the circles are: 770-740 cal BC for Circle D; 690-540 cal BC for Circle E; 740-680 cal BC for Circle F. The wood samples belonging to Circles B and C were impossible to collect this time. The <sup>14</sup>C age, 2655±25 BP, for the outermost ring of wood belonging to Circle B obtained by the previous work was calibrated to be 890-790 cal BC. The present experiment suggests that the formation of wooden circular structures lasted from 890 cal BC to 540 cal BC at the Mawaki site.

By applying the wiggle-matching analysis to 5 wood samples from Circle A structure at the Mawaki site, we were successful to assign the period of its formation in 50 years range. However, for other circles that can provide only limited number of wood poles to the wiggle-matching analysis, the precision of the age estimation was not good. The poor precision also resulted from the flat <sup>14</sup>C age structure against calendar age around this age periods in the IntCal09 calibration dataset.

Keywords: <sup>14</sup>C age, Jomon shell midden, wood circle, chestnut wood, <sup>14</sup>C wiggle-matching, layer of dolphin bones

## Stratigraphy and chronology of the late quaternary sediments from Lake Imuta-ike, Kagoshima, southern Kyusyu

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We present the stratigraphy and chronology of the sediment core from Lake Imuta-ike, southern Kyusyu over the last 30,000 years.

Lake Imuta-ike, is a volcanic crater lake, located on the southern part of Kyushu Island. The lake serves a protected natural habitat of rare animals, and is a registered wetland under the Ramsar Conservation. The environment of the lake and its vicinity is of particular importance, because there have been no geological studies so far.

We collected sediment cores from the lake in February 2011 for reconstructing the past environmental history of the lake since the last glacial period. Using the core, we undertook a series of analysis, e.g., lithological observation, non-destructive X-ray CT scanning, identification of tephras, <sup>14</sup>C dating and sequential measurements of physical properties and paleomagnetism. A part of these were used to build up the stratigraphy and the precise chronology of the core.

Sediment cores were taken up to the 25-m depth from the lake bottom, according to an overlapping method (e.g., Nakagawa et al., 2011) using a thin-wall and vibro-hitting sampler.

The lithology of the cores was composed of a peat layer to the 7.6-m depth, a mud layer (7.6 to 13.0 m) and a volcanic material complex called Shirasu (below 13.0 m). Six volcanic ash layers were visibly intercalated within peat layer, and four of these were wide-spread tephras: Sakurajima-5 (Sz-5) at 3.25 m (thickness: 7 cm), Kikai-Akahoya (K-Ah) at 4.53 m (21 cm), Sakurajima-11 (Sz-11) at 5.75 m (1 cm) and Sakurajima-Satsuma (Sz-S) at 6.60 m (32 cm).

Radiocarbon dates shows no stratigraphical contradiction. The date above the Shirasu layer (12.66 m) was 30,040±300 cal BP, showing a good agreement with the previously reported age of a pyroclastic flow when the Shirasu was deposited. The age-depth plots indicated that the beginning of the peat deposition could be at 15,000 cal yr B.P. This corresponds to the onset of B/A warm interstadial in LGIT. The average sedimentation rate was ca. 0.5 mm/year for the peat layer. The falling ages of the volcanic layers in Lake Imuta-ike were estimated to be 5.5, 7.1, 10.5 and 12.8 ka for Sz-5, K-Ah, Sz-11 and Sz-S, respectively. Our results are reasonably comparable with the those obtained from the eastern area of the Osumi Peninsula (e.g. Okuno et al., 1997).

The sediment of Lake Imuta-ike has a great potential for the paleoenvironmental study in this region over the last 30 ka.

Keywords: Lake Imuta-ike, tephra, the Sakurajima Volcano, the Ito pyroclastic flow, peat

## Middle Pleistocene tephrostratigraphy of C9001 core drilled by CHIKYU off Shimokita Peninsula and its application for in

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We described Middle Pleistocene tephra layers detected from C9001 core drilled by CHIKYU off Shimokita Peninsula, and attempted to correlate these tephra layers with those already identified on land by previous studies. Two pumiceous tephra layers found at 141.2 mbsf (meters below seafloor) and 146.6 mbsf are very similar to Tanabu B and C tephra, respectively. Tanabu B and C tephra are both derived from Osore-zan volcano located in the north part of Shimokita Peninsula. Two marine terraces named Toei and Kabayama from upper to lower have been formed before and after the depositions of Tanabu B and C tephra. In previous studies, the ages of Tanabu B and C tephra have been not determined precisely, resulting in two interpretations that the ages of Toei and Kabayama Terraces are MIS 9 and MIS 7, or 203-212 ka and 163-169 ka. Due to the isotope stratigraphic study by Domitsu et al. (2010), two tephra layers found at 141.2 mbsf and 146.6 mbsf are positioning in MIS 7. This will constrain the ages of Toei and Kabayama Terraces. A vitric tephra found at 154.8 mbsf is similar to Shiobara-Otawara tephra in the chemical composition of glass shards. Previous study concluded that Shiobara-Otawara tephra was derived from Shiobara caldera in the north part of the Tochigi Prefecture at 300-330 ka as a large ignimbrite and a plinian pumice fall deposit distributing with NNE axis. However, the age estimation (250 ka) by the isotope stratigraphic study by Domitsu et al. (2010) shows that the vitric tephra found at 154.8 mbsf is younger than that of Shiobara-Otawara tephra. It means that reconsideration of age estimation or correlation is needed.

Keywords: Chikyu, Off Shimokita Peninsula, tephrochronology, Osorezan-Tanabu tephra, Shiobara-Otawara tephra

## Stratigraphy of Middle to Lower Pleistocene tephra under Koriyama Basin, Northeast Japan

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In order to construct the stratigraphy of Middle to Lower Pleistocene tephra under the Koriyama Basin, Northeast Japan, a 100.33 m long boring-core was obtained at the Fukushima Prefectural Koriyama-kita Technical High-school (248.6m abs) located on the Koriyama Upland emerged between occurrences of Nm-SB tephra (110 ka) and DKP tephra (620 ka). We detected two well-studied Middle Pleistocene fall-out tephra and one Lower Pleistocene ignimbrite. A white fine pumice fall deposit with a thickness of 4 cm collected from 37.63-37.67 m in depth can be correlated to Sn-SK tephra derived from Sunagohara Caldera at 220 ka. A weather pumice fall deposit with a thickness of 16 cm collected from 38.24-38.40 m in depth can be correlated to So-OT tephra derived from Shiobara Caldera at 300-330 ka. A thick ignimbrite with a thickness of ca.11 m (69.60-80.37 m in depth) is similar to Asino Ignimbrite erupted Lower Pleistocene Caldera in south part of Fukushima Prefecture at 1.27-1.45 Ma. The recognition of these tephra constrains the age of the sediment filling the Koriyama Basin, providing significant information for consideration of the development of the Koriyama Basin.

Keywords: Koriyama Basin, Middle Pleistocene tephra, ignimbrite, Boring core, Koriyama Formation



## Postglacial melting history of the Greenland ice sheet and pre-historic Greenland culture

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The past melting history of the Greenland ice sheet is the great key for elucidating the future sea-level rising. The GIA (Glacial isostatic adjustment) model using the spatial and temporal variations of relative sea-level changes is one of useful techniques for the reconstruction of ice melting history. Although many radiocarbon dating ages for the reconstruction of the sea-level history have been obtained from the coastal area of Greenland (ex. Kelly, 1973; Ten Brink, 1974, 1975; Weidick, 1968, 1972 in West Greenland), the detailed geomorphological and Quaternary stratigraphical investigations have not been enough. For example, though Reeh (1989) and Henriksen (2008) compiled the map showing the amount of uplift during the Holocene along the coastal area of Greenland, some isolated high coastal existences of the place of the amount of upheaval suggest that the field confirmation of Holocene marine limits is questionable. In this presentation, we introduce the report of the reappraisal for height of the Holocene raised beach through geomorphological and geological approach and also mention the relation with archeological evidences of pre-historic Greenland culture.

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Keywords: Greenland, ice sheet, post glacial, pre-historic Greenland culture

## Holocene sea level changes in Inbanuma area

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Inbanuma area is situated in southern part of middle reaches of the Tone river. During the Holocene transgression period, paleo Kinu bay has formed on lowlands located along the middle to lower reaches of the Tone river (Endo et al., 1983). In regard to this area, many studies have been made about reconstruction of paleo environmental changes. So far Takagami lowland (Ota et al., 1985; Kashima et al., 1985), Kinosaki lowland (Sugihara et al., 1997; 2000; Masubuchi and Sugihara, 2011; Chiba et al., 2011) and lake Kasumigaura (Saito et al., 1990) were surveyed for paleo environmental changes by the Holocene transgression. However, timings and details of paleo sea level changes by the Holocene transgression is not emerged in paleo Kinu bay during Holocene. Besides, many shell mounds were made by Jomon and Yayoi people in coastal areas of this area in Holocene. Therefore, it is important that for geology as well as archeology to reconstruct paleo sea level changes in this area.

In order to reveal the details of sea level changes in Inbanuma area during Holocene, we have basically analyzed 3 cores, and drawn Age-depth and sea level curve. The results are as follows;

1. During 11000-7500 cal yrBP, Holocene transgression occurred and the sea level rose from -37m to +2m.
2. During 7000-2000 cal yrBP, sea level fell from +2m to 0m gradually.
3. Timing of Holocene maximum sea level between Sekiyado and Inbanuma area was almost simultaneously.
4. Shell mounds around middle to lower reaches of the Tone river were formed of adapting to changes of sea level, salinity, deposits, during the regression period.

Keywords: Inbanuma area, Holocene, Sea level change

## Tectonic tilting inferred from difference in Holocene relative sea-level changes among the sites in the Nobi Plain

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This study presents relative sea-level (RSL) curves since the middle Holocene for six core sites on the Nobi Plain, Japan, and considers the influence of vertical tectonic movements on RSL. The cores reveal a typical deltaic succession in which sedimentary facies can be divided into five units. In ascending order these are braided river (unit A), fluvial to intertidal (unit B), inner bay (unit C), delta front (unit D), and delta plain (unit E). Electrical conductivity (EC) in uppermost unit C is proportional to the thickness of unit D, and provides an indication of the water depth close to the top of unit C. We translated EC in unit C to water depth by applying the function  $y = 5.2x$  ( $x = \text{EC}$ ,  $y = \text{water depth}$ ). We then estimated RSL by adding the EC-derived water depth to the sea-floor elevation obtained from sediment accumulation curves derived from 115 <sup>14</sup>C ages. RSL at 6000 cal BP increased with distance from the Yoro fault system. RSL at the four core sites nearest the fault system has been rising continuously since 6000 cal yr BP, indicating subsidence in this area. This trend of continuous rise of RSL and the differences in RSL among core sites show that the Nobi Plain has been tilted down to the west in response to Holocene activity on the Yoro fault system.

Keywords: electrical conductivity, Holocene relative sea-level changes, Nobi Plain, sediment core, tectonic tilting, Yoro fault system

## Sand dunes development of Peski Saryishikotrau desert from the latest Pleistocene, in Kazakhstan

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### Introduction

In central Asia, deserts and semi-deserts develop in wide areas under the continental climate. In this area, research of past environmental evolution is important to estimate sustainability of human activities and water resources. Recently, some researches analyze of endorheic lake sediments in central Asia and show the lake level changes and dry-wet cycles in Holocene. In eastern Kazakhstan, around Lake Balkhash and Ili River delta, the Ili-project team revealed the environmental changes that e.g., lake level changes, the river meandering changes and terrace developments (e.g., Endo et al., 2010).

However, developments of erg (sand sea) and environmental changes about dry-wet cycles in central Asia are almost unknown. But, recently, Maman et al.,(2011) shows that sand dunes around Aral Sea region were formed from 7 to 5ka by OSL dating.

Peski Saryishikotrau desert located around Lake Balkhash and Ili River delta is known as a sand sea. But the development and environmental change records are unknown. This study aims to clarify the relationship between the evolutions of sand sea and climate changes in this desert area.

### Methods

Land surveying, magnetic susceptibility measurement, sampling for grain size analyses and OSL dating from some trench sites of sand dunes, were done in Aug.2010, Mar.2011 and Sep.2011. Geomorphological map and sand dunes map was created from DEM.

### Results and discussion

Field researches coupled with analyses of high-resolution satellite images indicate the most of sand dunes in this area have been already covered by vegetation. And, the result of DEM mapping classifies the sand dunes by wavelength (WL) and height (H) parameters. The group1 dunes (1km<WL<5km, H<50m) are Draa (mega longitudinal dune), the group2 dunes (0.5km<WL<5km, H<10m) and group3 dunes (WL<0.5km, H<10m) are mainly longitudinal dunes. And these dune patterns suggest wind regime shift in past time.

From the results of OSL dating(Kondo et al., 2011), the pre-Ili river terrace overlane by sand dunes of group2 and 3, gave the age of latest Pleistocene, and the sediments of group3 dunes indicate mid-Holocene. These results suggest that development of the group2 dune and group3 dune had continued from latest Pleistocene to mid-Holocene.

In addition to the developments of sand dunes, add other materials about environmental changes from the Ili project research, we discuss about the climate changes in central Asia from latest Pleistocene to mid-Holocene.

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**KEYWORDS:** Kazakhstan, central Asia, sand dunes, Ili River delta, Peski Saryishikotrau desert, prevailing wind

**Keywords:** Kazakhstan, central Asia, sand dunes, Ili River delta, Peski Saryishikotrau desert, prevailing wind

## Late Holocene fluvial landform chronology and paleo-climate in the middle basin of Ili River, Kazakhstan.

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### 1. Introduction

In drylands of Central Asia, precipitation change has a major effect on water environment especially hydrology. But about paleo-environment change little is known in this region. Ili River flows into Balkhash Lake from Tiensian Mountain. It has the largest discharge of the rivers flowing into Balkhash Lake and supplies 80 percent of the total inflow. In Balkhash Lake, several gravity cores have been obtained and Holocene lake level changes are reconstructed (eg., Endo et al., 2009; Chiba et al, 2010; Sugai et al., 2010).

Understanding the cause and mechanism producing such lake level changes is important to lead new insight into paleo-environment in the Central Asia. To know the relationship between Ili River behavior reflecting environmental conditions of the river its basin including Balkhash Lake.

In this study, the history of paleo-climate and avulsion were made clear up based on the analysis of fluvial deposits inc. the paleo-channel fill of Ili River.

### 2. Methods

Fluvial landforms of Ili River paleo-channels were classified by satellite images from google earth and DEM data from SRTM3. The paleo-channels were dated by AMS-14C method and OSL dating from the channel-fill deposits. Deposits were also examined on particle analysis and magnetic susceptibility.

### 3. Result and discussion

The middle part of Ili River was classified into five geomorphic surfaces from T1 to T5. T1 is covered with vegetated rough dunes. The outcrops eroded by Ili River has two cycles of fluvial sediment units which is upper-fining from middle sand to silt and are covered with sand dune. T2 is distributed along paleo-channel turning to the north at Bakbakthy. Aeolian sand dunes smaller than those on T1 surface covers T2 surface. The top of paleo-channels on T2 has well-sorted fine sandy sediments thought as aeolian sand. T3 is distributed along paleo-channel turning to the north at Bakanas and has paleo-channels which had larger discharge than modern channel (Shimizu and Sugai 2010).

T4 is distributed along the main stream of modern Ili River and formed after the main channel of Ili River moved to the west. Large Flood is likely to flow into paleo-channels on T4. T5 is the floodplain of Modern channel of Ili River and along the channel.

About 30ka after deposition of T1, T2 was formed before 4ka. Meanwhile, Balkhash Lake has a low-level period. 4.2ka from OSL dating (Kondo et al, 2011) is the last active age of paleo-channel on T2 after deposition age in the downstream of Kurti River (Sugai et al, 2012). And then the channel was covered with aeolian sand. T3 has four 14-C ages. Two of them obtained from shale in sorted sand thought as fluvial sediments show about 1500 years ago, the others show from humic soil showing that the channel changed back marsh about 700 years ago. That is to say, in high-level period of Balkhash Lake (Chiba et. al., 2010), the main channel of Ili River was forming T3 with repeating avulsion, and was moved to T4. And then T3 became terrace and covered with aeolian sand.

Keywords: paleo-channel, aeolian sand, paleo-discharge, Central Asia

## A record of Holocene lake-level change reconstructed from mineralogical analysis and acoustic profiling of the Balkhash

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### Introduction

Global warming is the matter in recent years. Although IPCC pointed out that the main factor is human activities, some mention importance of natural environmental changes. To understand actual cause, it is essential to investigate global environmental change and evaluate the influences of human activity. Restoration of local environmental changes is also significant, that enable to consider correlation of those among areas. Local and global climate of Holocene has been restored to know interaction between environmental changes and human activities. Recent study demonstrated that destruction of civilization occurred corresponding with abrupt climatic changes in some cases. This strongly suggests that climate changes have seriously damaged human society. While paleoenvironment of Central Asia which is semiarid has been restored by such as Mischke et al. (2010), the amount of records is short. Lake Balkhash which has the largest area in Central Asia and has recorded detailed paleoenvironment of the region was focused.

This research reconstructed lake level change of Lake Balkhash from the lake sediments with acoustic profiling, and discussed the cause of change comparing climatic changes in near regions.

### Study area and methods

The research area is the eastern part of the Lake Balkhash, where is the deepest with the depth of over 20 m. To restore lake level changes, lake sediment cores and acoustic profiling images of the sediments were analyzed. In acoustic profiling the change is captured by analyzing sequence stratigraphy. Two sedimentary cores of 0901 and 0902 were obtained and minerals in sediments were particularly analyzed because they record water quality and origin of the sediments.

### Results and discussion

Onlap and toplap structure were confirmed at each upper and lower stratum of reflecting boundary 2 identified in the acoustic profiling images of Line 11, respectively. Onlap structure is formed when water level rises, while toplap structure is formed when water level drop. Therefore, lake level drop phase changed into rise phase bordering the reflecting boundary 2 at Line 11.

Peak of X-ray intensity of quartz and feldspar in 0901 core and that of magnesite and gypsum in 0902 core were confirmed by identifying minerals based on XRD peak chart. Magnesite and gypsum in 0902 core formed under arid environment indicate water level drop. Quartz and feldspar rich horizon in 0901 core indicates increase of fluvial input into the lake suggesting lakeshore migration because of the lake level drop. As a result of core contrast, coarse grain deposition facies of 0901 cores are coincident with gypsum and magnesite of 0902 cores. Therefore, Lake Balkhash fell down its lake level rapidly at this time. Subsequently, terrigenous matter has deposited surrounding the Lepsy river mouth where 0901 core is situated whereas gypsum and magnesite has produced at around 0902 core far from the river mouth. Accumulation of gypsum and magnesite happened ca. 5500 cal years BP. After that, this horizon that shows water level decline is called as event horizon.

As a result of contrasting 0901 core with acoustic profiling of Line 8, the event horizon of 0901 core is coincident with the reflecting boundary of Line 8. Furthermore, the reflecting boundary of Line 8 is coincident with the reflecting boundary 2 of Line 11. Since the reflecting boundary 2 of the event horizon is concordant with the result of acoustic profiling, lake level drop phase changed into rise phase about 5500 cal years BP in Lake Balkhash. Other researches indicated that climate changed from wet to dry at various places ca. 5500 cal years BP. To summarize, the timing of lake level drop phase into rise phase ca. 5500 cal years BP in Lake Balkhash is coincident with climate change period from wet to dry. And Lake level change of Lake Balkhash is caused by aridification. This research clarified lake level change and contributed to discussion of climate change in Central Asia.

Keywords: Lake-level change, Holocene, Lake Balkhash, lake sediments, acoustic profiling, mineralogical analysis

## DNA analysis for identification of a *Pinus* pollen grain at subsection level found in Belukha Glacier

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We improved our method on DNA analysis for identification of a *Pinus* pollen grain. We presented a method that could identify a *Pinus* pollen grain found in Belukha Glacier, Russian Altai Mountains using polymerase chain reaction (PCR) technique. However the capability of the identification was still at section level and the success rate of PCR was 7.6%. The purpose of the present study was to identify the grain at subsection level and to obtain higher success rate newly using multiplex PCR technique. Fragments of 134-147 bp from five loci of the chloroplast genome in each *Pinus* pollen grain were amplified, and the DNA products were sequenced in order to identify them at subsection level. As a preliminary result, the success rate for sequence amplification in the present study was 35% and exceeded that of our previous study. *Pinus* is a taxon with approximately 111 recognized species in two subgenera, four sections and 11 subsections. From the sequences obtained for the six grains, four pollen grains were identified as belonging to subsection *Pinus*. Trees of *Pinus sylvestris*, in subsection *Pinus*, are currently found surrounding the glacier. The consistency of results for this subsection suggested that these pollen grains originated from the same *Pinus* trees found in the immediate surroundings, which spread also as far as Europe. Interestingly, other two grains were identified as subsection *Australes* that is found in North America, Mexico, Central America and Caribbean.

Keywords: glacier, pollen analysis, DNA, ice core, Russian Altai Mountains

## Fluvial dynamics of the Stung Sen River and geomorphic development processes in lower Mekong basin

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We conducted six drill core analyses and outcrop observations at two investigation sites of KC and KPT at the Stung Sen River downstream in lower Mekong basin. Study area is situated in low-latitude tropic region highly influenced by monsoon, and floodplain environment dramatically changes during each dry and monsoon season. The Stung Sen River is the biggest influent tributary of the Lake Tonle Sap, and its base level of erosion is water surface level of the lake. River longitudinal gradient in the downstream of the Stung Sen River where fluvial plain is developed is very gentle, around 0.06/1000. Floodplain landform of the Stung Sen River is surrounded by upland with less than 5-meter relative elevation, and is roughly divided into back marsh and meander belt consisting of meander scroll and abandoned channel. Sedimentary units of A, B, C, and D are recognized above sandstone basement rock. AMS-<sup>14</sup>C ages explain that back marsh (Unit A, B and C) has been accumulated in increments of 0.1 mm/yr since the late Pleistocene whereas deposits in meander belt (Unit D) are relatively new and have replaced in decennial to centennial time scale. Coarser deposits at upper KC site and more plant materials at lower KPT site came to accumulate after ca.11 ka, is probably due to rainfall increase derived from monsoon intensity. Landform development pattern diverges at downstream site of KPT. Lowest back marsh III was formed due to the Stung Sen's erosion of higher back marsh II at least after middle Holocene. This geomorphic process might be related to initiation of monsoon reverse flow between the Mekong and Lake Tonle Sap.

Keywords: fluvial landform, meander, drill cores, Stung Sen River, lower Mekong basin



## The initiation and depositional process of the lake sediments in Lake Tonle Sap, Cambodia

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Lake Tonle Sap is a part of the Mekong River Basin. In dry seasons, water flows from the lake through River Tonle Sap River into R. Mekong. Whereas, in rainy seasons floodwater from R. Mekong enters back into the lake.

Paleolimnological studies have revealed that the beginning of the lake formation and the phenomenon of the water reversal can be traced back to the early Holocene (Penny et al., 2005, Penny 2006, Day et al., 2010). However, the low sedimentation rate from the middle to early Holocene suggests that there could be a hiatus in cored sediments. In addition, no firm evidence has been provided as to whether to the bottom of cored sediments are the actual basement. To overcome these issues, we collected a 14-m long sediment core from the deepest part of the buried valley in the lake, where we observed the lake bed configuration using seismic records.

From the sedimentological analyses, we attempted to reconstruct the onset and subsequent process of sedimentation in Lake Tonle Sap.

Radiocarbon dating was undertaken for organic remains from the core. The onset of the lake environment in the Mekong basin was estimated to be ca. 11,000 cal yrBP, suggesting that the age of the lake formation may precede 2,000 to 3,000 years to those mentioned in the previous studies.

Sequential CNS records at an interval of 1 to 5 cm (n = 406) were obtained to clarify the temporal changes in depositional process of the lake. Our results suggested that five stages are identified as below:

Stage 1 (Depth 14.0-13.2 m): ave. 1 wt% of TOC (total organic carbon) contents and 10-20 of C/N ratio represent the transition between fluvial and lacustrine environments.

Stage 2 (13.2-8.1 m): ave. 2 wt% of TOC, 9-10 of C/N ratio and ave. 80 of C/S ratio represents a closed lake environment in which the valley was gradually filled with fine materials from surrounding.

Stage 3 (8.1-3.3 m): ave. 1 wt% of TOC, 5-6 of C/N ratio and ave. 35 of C/S ratio represents a moderately stable closed lake environment with an increment of lake productivity.

Stage 4 (3.3-0.6 m): 2-4 wt% of TOC, 11 of C/N ratio and ave. 0.15 wt% of TS (total sulfur) contents represents a closed lake environment with a seasonal fluctuation.

Stage 5 (0.6-0.0 m): ave. 1 wt% of TOC, 5-6 of C/N ratio and ave. 35 of C/S ratio represents the modern lake environment.

Keywords: Lake Tonle Sap, buried valley, sediment core, CNS element analysis, magnetic susceptibility, Holocene

## Geoenvironment around the ancient dams at PPNB archaeological sites in Jafr Basin, southern Jordan

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Wadi Abu Tulayha is a small settlement site located north-west of the Jafr Basin in southern Jordan. PPNB agro-pastoral outpost was probably derived from the secondary farming society to the west. Ancient dams set along the wadi channel were excavated at the site and several dams that have similar features were found in Wadi al-Nadiya, Wadi Quweir, and Wadi Ruweishid ash-Sharqi sites located in Jafr Basin. In order to clarify natural backgrounds for these ancient dams, surface drainage and catchment area were estimated by calculating digital elevation model (DEM) and analyzing remotely sensed images. Considering its geological backgrounds, hydrology including underground water in the limestone-based sedimentary rocks may play an important role on the nomadic people's settlement.

Keywords: PPNB, Ancient dams, Limestone, Jafr Basin

## The Eruption Age of 31 Tephra Intercalated in the Late Pleistocene Sediments off Joetsu, Japan

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### Introduction

The Age is necessary for the paleoenvironmental studies. The tephra spreaded and deposited in wide area by volcanic explosive eruption play the important role of the time marker in Japan (Machida and Arai 2003). In previous studies, B-Tm, K-Ah, To-H, As-K, NJ2, KsP, AT, B-J, SAN1, U-Ym, Aso-4 and Toya tephra were found in Japan Sea (Ikehara et al., 2004 etc.). Most of these tephra were found from the core extracted offshore in Japan Sea. On the other hand, since sedimentation rate is high in the near coast of Japan Sea, previous studies revealed environmental changes only since about 60,000 years ago. There is almost nothing that was established as a means to acquire the age value before 50,000 years ago. Therefore, it is very important to know the tephra stratigraphy before 50,000 years ago in Japan Sea and to presume the eruption age of tephra. Based on the distributions of each tephra in precedence research, many tephra will be found off Joetsu. This study asked for the eruption age of 95 tephra obtained from 9 core samples extracted in the Joetsu basin circumference region.

### Study Area

The Joetsu basin which is located in the east of the Toyama trough has various geographical feature places such as Umitaka spur, Joetsu knoll, submarine canyon. Most core samples extracted there consist of muddy sediments. The core extracted at the lower part of a slope or a submarine canyon contains the slump sediments and the landslide sediments. When depositional environment is calm, TL layer peculiar to Japan Sea (Tada et al., 1999) is formed. Into such a core, tephra with a coarse size is inserted.

### Methods

For each individual samples, mud was removed for the samples using sieve, and the remainder was placed inside the ultrasonic washing machine. Then, the mineral composition and volcanic glass shape was indicated using the microscope, and the chemical composition of volcanic glass was analyzed by SEM-EDS. Based on the feature of each tephra, tephra was correlated.

### Results

95 samples were classified into 31 kinds, and 11 kinds of them were identified by the tephra the age is presumed to be by precedence researches. As-K(15-17.5ka; Machida and Arai 2003), AT(29.24ka; Kitagawa and Plicht 1998a), Spfa-1(42-44ka; Machida and Arai 2003), DKP(62ka; Nagahashi et al. 2007), On-Ng(85.1ka; Nagahashi et al. 2007), Aso-4(88ka; Oba 1991), On-Kt(94.9ka; Nagahashi et al. 2007), K-Tz(95.2ka; Nagahashi et al. 2007), On-Pm1(97.6ka; Nagahashi et al. 2007), SK(99.9ka; Nagahashi et al. 2007) and Toya(106ka; Shirai et al. 1997) were correlated. On the other hand, the eruption ages of 20 kinds of tephra were not clear. Then, we estimated the eruption ages on the assumption that depositional environment has been calm.

95 samples were classified into 31 different kind of tephra, and 11 of them were identified by the tephra whose ages have been established by precedence researches. Each eruption age of unknown tephra was estimated based on depth of those identified tephra. The 31 eruption age were inserted in sediment of Japan Sea after 120,000 years ago.

### Acknowledgements

This study has been financially supported by the cooperative research project of the MH21 Research Consortium Japan.

Keywords: Tephra, Japan Sea, Chronology, Late Pleistocene, Eruption age, SEM-EDS

## Radiocarbon dating of AT ash

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Tephra layers formed by large volcanic eruptions have often been used as time markers in geology and archeology to correlate spatially distant events. Exact timing of tephra depositions therefore a key parameter in these studies. There are several radiometrical methods to date tephra layers. Radiocarbon (<sup>14</sup>C) measurements on buried wood are conducted for the sample whose age is younger than 50,000 years. Direct dating on tephra layer itself can be done using K-Ar dating for the samples older than approximately 100,000 years old. However several lines of problems are arisen for these radiometric methods. Radiocarbon results older than 20,000 years which was conducted for buried woods and charcoal scattered and did not give a precise age of the tephra layer due to secondary contamination after its deposition. It has been reported that the choice of measurement methods, namely <sup>14</sup>C measurement by liquid scintillation counter (LSC) and accelerator mass spectrometry (AMS), produces inconsistent age results on same samples.

Keywords: radiocarbon diting, AT ash, tephra

## Luminescence chronology of marine and fluvial terraces of Middle Pleistocene using post-IR IRSL method: A case study in H

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In Hokkaido, it has been difficult to construct a detailed chronology of marine and fluvial terraces before MIS 5 using tephrochronology, due to the lack of the marker tephtras and to the deformation of original landforms by strong past periglacialiations. The lack of age constraint has prevented studies of precise geomorphic development and palaeoenvironmental reconstruction in this area.

This study applies an elevated temperature post-IR IRSL (pIRIR) SAR method of luminescence dating using polymineral fine grains to marine / fluvial terraces before MIS 5 in northern / southern Hokkaido pIRIR method is a new techniques in the luminescence dating. This method has advantages that there are no anomalous fading in feldspar luminescence signal and is applicable to older sediments beyond the age range of quartz OSL dating.

In this study, polymineral fine grain samples taken from marine terrace deposits and loess covering fluvial terraces were used to test the pIRIR datings.

In Hamatonbetsu area, northern Hokkaido, the pIRIR  $D_e$  values from the lower marine terraces are ca.250 Gy, and ca.750 - 850 Gy from the middle marine terraces.

In Yurappu river area, southern Hokkaido, the  $D_e$  values of ca.150 Gy, and ca.500 Gy were obtained from the middle fluvial terrace and from the higher fluvial terrace, respectively.

These  $D_e$  values of pIRIR for all samples (from marine and fluvial terraces) are generally in the stratigraphic order.

Our data will provide new age estimates for the loess and sediments from the marine and fluvial terraces. These new ages of the terraces will give excellent chronological information for geomorphological development and paleoenvironments in northern Japan.

Keywords: pIRIR, marine terrace, fluvial terrace, Hokkaido, chronology

## Chronology of Kanto Loam formations and Late Pleistocene fluvial terraces using OSL and pIRIR dating in the Kanto plain

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In the Kanto plain, chronology of fluvial and marine terraces has been reconstructed mainly by Kanto Loam formations and key tephra. However, since key tephra are not so common in Musashino Upland, application of new chronological measurement method is necessary. At first OSL dating was applied to Tachikawa Loam. However, OSL ages were estimated to be too young. Since abundant quartz grains are contained in sediments of younger volcanic origin. Consequently, new chronological measurement method, the pIRIR dating method was applied to some tephra horizons in Tachikawa and Musashino Loam, and terrace deposits.

From AT tephra horizon along Hanamuro-river, Tsukuba, the OSL age value about 14 ka was obtained and the pIRIR age value about 30 ka was obtained. Tsurugasima, Saitama, the pIRIR age value was about 30 ka for AT tephra horizon. In Tachikawa, Tokyo the OSL age value was about 27 ka and the pIRIR age value was about 30 ka for AT tephra horizon. These results indicate clearly that the pIRIR dating is a useful method to determine ages of late Pleistocene Kanto Loam, tephra and terrace deposits at least in Kanto, even if those include young volcanic Quartz.

Keywords: OSL dating, pIRIR dating, Kanto-Loam, Tachikawa terraces, Musashino terraces, Tephra

## Chronology and processes of fluvial terrace formation in the Ohmi Basin based on cryptotephra analysis

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In Japan, processes of terrace formation were generally explained by climate and sea-level changes (e.g. Kaizuka, 1969). In downstream areas, sea-level changes affected terrace formations such as marine terraces during interglacial periods and buried terraces during glacial periods (e.g. Kubo, 1997). In mid-upstream areas, changes of water discharge and sediment supply due to climate changes mainly affected terrace formations such as aggradational terraces during glacial periods (Hirakawa and Ono, 1974; Sugai, 1993). However, it is difficult to distinguish the affects of climate and sea-level changes to terrace formations because these study were conducted in the rivers, whose profiles show smooth concave shape from downstream to upstream. This study focused on the Ohmi Basin to understand the processes of terrace formation under the uniform altitude of base level of erosion (Lake Biwa). In this study, cryptotephra analysis of eolian deposits covering fluvial terrace deposits was carried out to identify tephra horizons. Based on tephra horizons (K-Ah, AT, K-Tz) and geomorphic features of fluvial terrace surfaces, processes of fluvial terrace formation in the Ohmi Basin were discussed.

Keywords: Tephrochronology, Ohmi Basin, Fluvial terrace

## Regional characteristics of river long profile development in mountain areas, Japan since the Last Glacial Period

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Longitudinal river profile is one of the most important geomorphic elements indicating river transportational systems, which changes in response to climate change. As the result, river terraces are developed. Therefore, quantitative researches of river longitudinal profile should be examined to clarify the response of rivers to climate change. River terrace development in the latter half of the last glacial period is different between East and West Japan. Investigating the factor that produced those differences is important to estimate river changes that may occur in the future. In addition, previous studies have clarified river landform changes in individual rivers since the last glacial period, but there are few quantitative studies that focus on rivers all over Japan. This study tries to clarify the long-term river landform changes and at the same time shed light on each region's characteristics by comparing river longitudinal profiles in different areas in Japan. The investigators compared between the Last Glacial River Profile defined by the continuity fluvial terrace surface formed since the Last Glacial Period and the Present River Profile. River longitudinal profiles were fitted with one of the exponential, power or linear functions. Discussion regarding the conformity function type used for evaluating the rivers in East and West Japan will be shown in the next poster session.

Keywords: river longitudinal profile, fluvial terrace, climate change, fluvial system



## Diatom assemblages from the event sediments of the AD core at the Odaiba-Oume, Tokyo Bay Area

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The AD core, at the Odaiba-Oume, Tokyo Bay Area, was 60.90 m long core of alluvial deposit along the paleo-Kanda River Valley. Isomae (2011MS) divided the core into ten sedimentary units and presumed that the upper-most Unit (Unit 10) including several sedimentary structures was tidal deposit. But the evidence of reconstruction to this unit has another possibility. So we presumed the detail paleo-environment at Unit 10 and discussed the relations between sedimentary structures of the core and natural hazard events using diatom assemblages.

We took the samples for diatom analysis with 2-5 cm intervals according to the litho-faces changes the Unit 10. The dominated species from the unit were inner bay assemblages such as *Thalassiosira* spp. and *Thalassionema nitzschioides*, and the numbers of freshwater species were less than 10 percent to the total diatoms. Although the assemblages were hardly changed within the Unit 10, the number of diatom fossils per gram has fluctuated cyclically. These changes were presumably related to the flooding process changes at the hazard events in the last 800 years.

Keywords: Diatom, Tokyo Bay, Event sediments

## Shallow topography of occurring liquefaction sites in Urayasu city, Chiba prefecture

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Liquefaction deteriorates seismic disasters because it tends to occur at lowlands where lots of people live and infrastructure concentrates. The research of liquefaction was started from 1964, when occurred Great Alaskan Earthquake and Niigata Earthquake, and it was revealed where liquefaction tends to occur, based on topography, geology and microtopography. The previous studies found out that high groundwater level, loose sand deposited and strong earthquake are main conditions for liquefaction. Landfill areas satisfy these conditions. In fact, liquefaction occurred landfill is but all landfill is not occurred.

The objectives of study are quantitative assessment of liquefaction risk. To this end, we focused on the sedimentary structure of the subsurface and visualized of shallow topography to find out the character of liquefaction sites.

Study area is Urayasu city, Chiba prefecture. Urayasu city was occurred liquefaction in The 2011 off the Pacific coast of Tohoku Earthquake. Landfill is the highest probability of liquefaction in the earthquake, so it is necessary to find out the shallow topography of liquefaction sites in landfill.

To clear up shallow topography, I subject to extract of (1) groundwater level (2) thickness of landfill (3) thickness of sand layer and make out bathymetric images and three-dimensional images. To visualize the groundwater level, it was found to be not straight line. And it was found that liquefaction has occurred in a location close to the surface of groundwater levels.

And also to visualize the landfill and the sand layer, it was found that the meandering shape of the surface and groundwater level is different.

To consider the overlapping liquefaction sites and groundwater level, groundwater level has lowered in places where liquefaction has occurred. It has been reaffirmed that the height of the groundwater level is defining of the occurrence of liquefaction.

Keywords: earthquake, liquefaction, shallow topography

## Formation mechanism of cloudy water in tide pool in methane seepage area, Kujukuri-hama beach, Chiba, central Japan

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In the study area, Holocene series unconformably overlies the Pleistocene Kazusa Group. The Kazusa Group was deposited mainly in a deep sea environment, and contains methane gas dissolved in water. This condition allows gas to emerge easily from the ground as it moves upward through faults and the sand layer.

In 2007, the water in tide pools at Kujukuri-hama beach in Chiba became cloudy. A field survey revealed that methane gas was seeping out around these tide pools where the cloudiness occurred and that bluish gray sand, which represents a reduction condition, is distributed inside the area of gas seep. Yellow groundwater was found lying immediately beneath the area where the bluish gray sand was distributed, and this yellow groundwater became cloudy as it emerged into the tide pools.

Results of analysis indicated a state of sulfate reduction and that the cloudy substances were mainly composed of elemental sulfur. It is thus suggested that the water in the tide pool became yellow or cloudy in the presence of polysulfide ions or irregular reflections induced by colloidal sulfur.

16S rRNA genes of anaerobic methanotrophic archaea belonging to ANME-1 were detected from the yellow groundwater. This suggests the possibility that anaerobic oxidation was involved in the reduction of the sulfate ions. Based on these findings, we propose a hypothesis of mechanism in which the ANME-1 are active along with the gas seeping from the Kazusa Group to the ground surface, and that the reductive condition was eventually formed at the surface.

Keywords: methane seepage, yellow groundwater, cloudy water, ANME