Geomorphological evolution of Notsukesaki barrier spits resulting from seismotectonics along the southern Kuril Trench

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An active barrier system is developed in the Nemuro Bay area along the Okhotsk Sea in eastern Hokkaido, Japan. This presently rare feature consists of a lagoon (the Notsuke Bay), a flood tidal delta, barrier spits, and a tidal inlet that opens into the outer sea of Nemuro Bay and the Sea of Okhotsk. The Notsukesaki barrier spits are active along the northeastern side of the Notsuke Bay, and four spit groups (NBS1~NBS4) can be observed clearly. Using geomorphological and sedimentological methods, we analyzed Holocene sediments around the Chashikotsu lowland and Natsukesaki barrier spits. We dated them using radiocarbon and tephrochronological methods. The Notsukesaki barrier system has been established before 4.0 ka presumed by Ma-d tephra. NBS1, the modern transgressive spit was formed after the 17th century, and NBS2 was caused by the last seismic uplift in the 17th century because Ta-a and Ko-c2 tephra covered the surface of NBS2. NBS3 was uplifted in the 12~13th century, and NBS4 was caused by seismic uplift maybe before the 10th century because Ma-b tephra covered the surface of NBS4. These great earthquakes (Mw8.5~9.1) have occurred at an approximate 500-year interval along the southern Kuril subduction zone. Coastal areas were raised by 3~ m during or just after the earthquakes due to postseismic displacement. Conversely, land subsidence has been ongoing at a rate of about 1.5 mm/year since the 17th century. We conclude that the geomorphological evolution of the Notsuke barrier system has been controlled by the seismotectonics along the Kuril subduction zone.

Keywords: Notsukesaki barrier spits, seismotectonics, southern Kuril trench, geomorphological evolution, eastern Hokkaido

Stratigraphy of the Middle to Late Pleistocene in the southwest Hokkaido, Japan

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The Middle to Late Pleistocene Setana Formation and Ohyachi Formation is distributed in Setana Plain, southwestern Hokkaido, North Japan. The Setana Formation consists of tuffaceous sandstone in Setana Plain. This is sandwiched by the Ohya Formation and Kuromatunai Formation.
Sedimentary age of Setana Formation has been estimated to be 1.2 Ma to 0.6 Ma by biostratigraphic investigation. But there aren't a lot of previous research about Stratigraphic Relation between Ohyachi Formation and Setana Formation and that's geomorphic development.
Recently, Kondo et al. (2016) got Setana Formation's and Ohyachi Formation's conclusive age by OSL. The purpose of this study is to clarify the Stratigraphic Relation and the paleo-environment by Sedimentary age.

Keywords: southwestern Hokkaido, Setana Formation, Stratigraphy

Characteristics and Development Processes of Wetlands on Large-scale Landslide in Ou Mountain Range, NE Japan

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Quaternary volcanoes in the Ou Mountains, northeastern Japan, are occasionally dissected by large-scale landslides with their areas greater than 1 km^2. On these landslide bodies various-size wetlands have been formed in the landslide depressions and contribute to creating mosaic landscapes and biodiversity of landslide areas with the steep scarps and forests. Since establishment ages of wetlands on landslide bodies reflect the timing of landslide activities, simultaneity of wetland formation in a single active landslide is inferred. However a large landslide contains coexisting wetlands of various development stages, including ponds and peat bogs. This contributes to further diversity of their landscapes and biota. This study examines geomorphological controls on the distribution and development of wetlands on large-scale landslides in the Ou Mountains.
We mapped in detail the microtopography of the landslides and identified ponds using color aerial photographs (1 : 18,000 and 1 : 15,000 scale) taken by the Geographical Survey Institute in 1976. We then calculated the slope inclination and the curvature, and mapped the drainage system from the GSI (the Geospatial Information Authority of Japan) 5-m or 10-m digital elevation models (DEM) using ArcGIS.
We selected 3 landslides in the Hachimantai Volcanic Groups and 2 in the Funagata Volcanic groups. These landslides have degraded caprock structure of the soft Neogene tuff covered with lava flows. The landslides on the Hachimantai are rotational ones that feature arcshaped scarps and stepped terrain in their upper parts. They have more fragmentary structures in their middle and lower parts. The secondary landslides commonly deform the feet of main landslides and contribute further to the undulating surface. Whereas these on the Funagata Mountain are translational landslides that feature rectilinear shaped scarps and constant height of block structures due to tensile stress.
Wetland distributions are controlled by microtopography of landslide bodies, and the wetland area is determined by the size of the depressions. The wetlands are mostly elliptical shape with long axes parallel to the linear depressions. On the Hachimantai, the wetlands in the middle and lower part of the landslide bodies tend to be smaller due to fragmentary topography. On the secondary landslides, a few wetlands stand only at the foot of the main scarps or in the depression between pressure ridges, because the soft material (earth flow) could not form depressions perpendicular to the slope direction. On the Funagata Mountain, the wetlands stand in the depressions between the scarps and in the cracks that are widely scattered over the landslide bodies.
All landslides in this study contain both ponds and peat bogs, different development stages. Sediment accumulation, connecting drainage channels and shortage of water recharge are considered to be major factors of wetland development from ponds to forests via peat bogs. The superposition map of the wetland distribution and the drainage system draws that the greater part of wetlands are connected to drainages whether water constantly flows or not through them. The peat bogs or forests (the latter stage of wetland development) tend to connect to higher order deeper streams. Therefore the degree of fluvial dissection of landslide bodies controls wetland development stage on the landslides. Landslide dams, such as the Nagamuma on the Funagata Mountain, with abundant recharge water from the upstream area could continue to be pond for a longer time than the other wetlands.

Keywords: wetland distribution, landslide, development process, Ou mountains

Relationship between Holocene sequence of the Tsuya plain and subsidence trend along the southern Sanriku coast, northeast Japan

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The Sanriku coast has some small alluvial plains at environments of rias coast. Although lithofacies of the incised valley fills is reported in some alluvial plains in the Sanriku area, formation process of the valley fills had not been discussed on the basis of many radiocarbon ages in the previous studies since 1980's . Knowledge of incised valley fills with many radiocarbon ages can be basic and important data for not only understanding of formation process of alluvial plain but also clarification of tectonic history in this area. A sediment core, TY1, was acquired from lower reach of the Tsuya Plain, northeast Japan. Core sediments show shallow marine succession influenced by the Holocene sea-level change. On the basis of twelve radiocarbon ages, accumulation rate is high (> 10 mm/yr) at 9,000 to 7,100 cal BP, low (ca. 0.5 mm/yr) at 7,100 to 2,800 cal BP, and high (3 –5 mm/yr) after 2,800 cal BP. High accumulation rate at early to middle Holocene indicates sedimentation from seaward area during the term of marine transgression. In the regressive phase since the middle Holocene, low accumulation rate in the deltafront deposits and high accumulation rate in the delta plain deposits shows most of sediments are deposited in delta plain area, indicating continuous rising trend of relative sea-level (RSL) during the Holocene. This suggested rising trend of RSL is consistent with previously reported Holocene subsidence in the southern Sanriku coast.

Keywords: Sanriku coast, Tsuya plain, Holocene sequence, radiocarbon dating, subsidence

Tephras and fossil pollen stratigraphy of all-cores drilled in the eastern margin of the Aizu basin, Northeast Japan

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1. Introduction

Aizu Basin is one of tectonic basins aligning with north-south direction in the south part of Northeast Japan. Along the west and east margin of the basin, the West Aizu Basin Fault Zone and the East Aizu Basin Fault Zone, active reverse faults, stretches respectively (e.g. Ikeda *et al*., 2002). Geomorphic development of the basin since Miocene has been discussed by Suzuki *et al*. (1977), Yamamoto (2006) and so on. Activity of both fault zones during the last a few ten thousand years was reported by Fukushima Prefecture (2002) and AIST (2007). Kuriyama and Suzuki (2012) and Suzuki *et al*. (2016) discussed late Quaternary tephrostratigraphy based on analysis of a drilling core (AB-12-2 core, 179.08 m asl) and another boring cores in the western part of the basin.

In this study, we drilled two all-cores (GS-SOK-1, 175.99 m asl, 130 m depth; GS-AZU-1, 208.36 m asl, 100 m depth) in the eastern margin of the Aizu basin. Ishihara et al. (2015) reported analysis of tephras and radiocarbon ages of the GS-SOK-1 core. In this report, we show fossil pollen stratigraphy of the GS-SOK-1 core, and lithofacies of the GS-AZU-1 core and detected tephras.

2. Fossil pollen stratigraphy of the GS-SOK-1 core

15 muddy sediment samples were collected from GS-SOK-1. The Pleistocene sediments in the GS-SOK-1 were divided into 10 local pollen assemblage zones (SOK-I, -II…, and –X, in ascending order) an informal nomenclature by a distinctive assemblage of taxa, indicating local environmental conditions as a rudimentary biostratigraphic classification. We compared these zones with local fossil pollen assemblage zones of Nanaorezaka Formation (lower Pleistocene) and Todera Formation (middle Pleistocene) in the western margin of the Aizu Basin (Suzuki *et al*., 1990).

Because Tertiary flora (*Metasequoia*, *Keteleeria*, *Carya*, *Liquidambar*) are slightly included in the SOK-I zone (the depth of 111.1 ~ 126.8 m), the SOK-I zone can be correlated with TD-I zone (Nanaorezaka Formation; Suzuki *et al*., 1990). SOK-II, -III, and -IV zones (78.1 ~ 104.3 m depth) can be compared with TD-II ~ -IV, -V ~ -VI, and -VII zones (Todera Formation; Suzuki *et al*., 1990), respectively. SOK-V ~ -X zones (23.5 ~ 72.9 m depth) includes *Fagus* and *Quercus* dominantly (except SOK-V zone), whereas Pinaceae are detected dominantly in the upper part of Todera Formation in Suzuki *et al*. (1990). Thus, it is suggested that these zones are younger formation than the Todera Formation.

3. Lithofacies of the GS-AZU-1 core and detected tephras

In the depth from surface to 52.5 m, dark grey or green grey silt, peat, and sand are dominant excepting gravel layer in the depth of 36.5 ~ 41.6 m. Several volcanic ash and pumice layer are detected. Characteristics of volcanic glass shards and containing colored mineral indicates that AT (29-30 ka; Machida, 2011) is included in the depth of 13.35 ~ 13.38 m and Aso-4 (87 ka; Aoki *et al*., 2008) is in 30.25 ~ 30.30 m. A lot of biotite are contained in a pumice layer (34.10 ~ 35.10 m) and a volcanic ash layer (52.35 ~ 52.40 m), indicating that they were supplied from the Oku-Aizu (Numazawa or Sunagohara) Caldera.

From 52.5 m to 91.3 m depth, green grey or yellow brown sandy silt or sand with pumices and phenocrysts mineral such as quartz are dominant and a thin gravel layer is at the depth of 76.3 ~ 78.7 m. It is suggested that these sandy silt and sand layers are pyroclastic flow sediments and

their rework sediments. Below 91.3 m the core consists of yellow brown or grey white volcanic sand and silt. The pyroclastic flow sediments can be correlated with the Shirakawa pyroclastic flow units (lower Pleistocene; Yoshida and Takahashi, 1991; Yamamoto, 2006) if above volcanic ash layer is the tephra from the Oku-Aizu Caldera.

Keywords: Aizu Basin, Boring, Tephra, Fossil pollen, Quaternary

Tephra of the Upper Pleistocene Joso Formation, Shimosa Group in the western Tsukuba Upland, central Kanto Plain

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Most of the terraces in the Kanto Plain were formed on and after Marine oxygen-Isotope Stage (MIS) 5e. Palaeo-Tokyo Bay spreaded in MIS 5e was becoming regression gradually. The geomorphic surfaces of MIS 5e were formed by Kioroshi Formation, and the geomorphic surfaces of MIS 5c and MIS 5a were formed by Joso Formation, in the Tsukuba Upland. Joso Formation has been classified by geomorphic surface classification, tephrochronology and sedimentary facies analysis. The purpose of this study is to make the improvement of a time axis in Joso formation from sedimentary facies analysis and tephrochronology targeted for the western Tsukuba Upland over the central Ibaraki Prefecture. The results, 2 to 4 sedimentary units of the marsh and channel facies are recognized Joso Formation in the Ryugasaki Lower surface (Ikeda *et al.,* 1982) , Joso surface (Unozawa *et al.,* 1988) and Joso, Ishizuka surface (Ooi *et al.,* 2013) . Hk-TP tephra (66ka; Aoki *et al.,* 2008) is recognized from Kanto loam Formation. On-Ng tephra (about 85ka; Nagahashi *et al.,* 2007) or On-Pm1 tephra (about 96ka; Aoki *et al.,* 2008) , and so on were confirmed from Joso Formation by the mineral composition and the chemical composition of the glass. It's expected that this study offers essential datum about the landform evolution in surrounding Upland and the Joso Formation study.

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Keywords: Kanto Plain, Tsukuba Upland, geomorphic surface, Upper Pleistocene, Joso Formation, tephra

Shallow subsurface structure in Magame - Katakai area, Kujukuri coastal plain, Chiba prefecture

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A shallow seismic reflection survey was conducted in the Kujukuri coastal plain, Chiba prefecture, targeting between a dozen meters and 300 m in depth to reveal the location and shape of buried valley topography inferred below the Alluvial sediment. The survey area is along the coast between Magame and Katakai of Kujukuri town where a buried valley is inferred from an existing geological map. The survey parameters are as follows. Line length:4486m, seismic source:P-wave Yuatsu impactor(JMI200), vertical stack:10, source point interval:2m, no. of source point:2242, receiver:GS20-DM(28Hz single), receiver point interval:2m, no. of receiver point:2244, spread:roll along from the first to 48th station for 192 fixed receivers, maximum offset:382m, recorder:DSS-12, no. of recording ch:192. First breaks arrive to the maximum offset and the deepest reflection waves appear down to 500ms in two way time in the vertical stacked and gained shot records. Source and receiver couplings to the ground seem good on a sandy beach. Reflectors are perceived between a dozen ms and 250ms in the CMP stacked time section. A reflector is strong and continuous, dips northward very gently between 20ms and 30ms in the whole seismic section. It seems obscure at two parts. Assuming that the velocity is 1.6km/s, this reflector is between -16m and -24m below sea level. This is 10m to 20m shallower than the Alluvial depths of the above geological map, but almost the same as those of the compiled boring data. This reflector is considered as the Alluvial base. In the southern obscure part, first breaks of near offset traces are superimposed by coherent noise. Discontinuous reflectors of 100m to 200m in length exist between 40ms and 70ms dispersively. These may have something to do with natural gas (Uwa gas). Reflectors are obsucure between 100ms and 170ms and reflectors are strong and uneven between 170ms and 250ms. Below the Alluvial sediment are strata of the Kazusa group.

Keywords: Kujukuri coastal plain, seismic reflection survey, Alluvial base, buried valley

On-Pm1 tephra and marine deposits covering the tephra in the Choshi district, eastern Kanto Plain

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In the Choshi district, eastern Kanto Plain, Shimosa Upper Terraces are widly distributed which are composed by the Katori Formation correlated with the Kioroshi Formation of the Shimosa Group. Shimosa Lower Terraces and younger geomorphologic surfaces are distributed in the east side of the Choshi district (Sugihara, 1976; 2000; 2008). Nakazato et al. (2015) detected the tephra that abundantly contained pumice type volcanic glass and hornblende. They showed the possibility of the correlation between the tephra and On-Pm1, based on the refractive indices and chemical compositions of the volcanic glass and hornblende.
The Zircon U-Pb dating using LA-ICP-MS (Ito, 2014) was applied to the tephra in this study. As a result, the obtained age of 100±60 ka improved the reliability of the correlation between the tephra and On-Pm1.
The outcrop where the tephra was detected shows the following stratigraphy: mud and sand stone of the Kasuga Formation of the Inubo Group, unconformity, shoreface sand, terrestrial mud interbedding the tephra (On-Pm1), shoreface sand with *Macaronichnus* isp., beach sand, fluvial deposits, Younger Kanto Loam and Holocene dune deposits in ascending order. The age of marine sand overlying the On-Pm1(95.7±5.3ka: Aoki et al., 2008) is more likely to be MIS5a.
Reexamination is necessary about the geomorphic and geotectonic history in this district because it has been assumed that the MIS5a surfaces are distributed in lower altitude area than this point.
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Keywords: MIS5c, tephra, geomorphic surface

Evolution process of the oyster reef and the ecology in Sanzanze, northeast Tokyo bay

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Living oyster reefs were first found about early 2000s at Sanbanze, a sandy and muddy tidal flat in Funabashi City at the northeast end of Tokyo Bay. Large reefs of Crassostrea gigas emerged only at the lowest point of spring tide, attracting public attention. After the peak of the development of the oyster reefs in 2008, the activity started to decline in 2009 and the ecosystem have been changed. The evolution process of the ecosystem, and its response to environmental conditions around the reefs, are key to understanding the present ecosystem, and also the environmental changes.
Oyster reefs, and also size and shape of individual oyster shells must be influenced by such environmental factors as nutrient salt, water temperature and habitat density in addition to weather condition, salinity, turbidity and so on (Chinzei, 1982, etc.).
In this study we investigate the relationship among changes in morphology through the growth of oyster reefs and individual shells, evolution process of the reefs and environmental factors in and around the reefs.
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Keywords: Tokyo bay, Oyster reef, Evolution process

Depositional system of the early Pleistocene Inagi Formation, Kazusa Group in the northwest Tama Hills, central Japan

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The Tama Hills is composed by the late Pleistocene to middle Pleistocene Kazusa Group. The Kazusa Group is typically distributed in the Central Boso Peninsula and composed underground of the Kanto Plain and hills edging the plain. Fossils of mollusk, animals and plants occur from shallow marine to non-marine Kazusa Group in the Tama Hills. Because, the Kazusa Group of the Tama Hills reflects environmental changes such as eustacy, it is important to reconstruct the paleo-environmental change the Early Pleistocene in the southern Kanto region with investigation of this area.
In this study, we focus on the Inagi Formation distributed in the northwest Tama Hills. The lower to middle member of Inagi Formation are composed of gravel and sandy silt respectively, whereas the upper Member of is composed by sand (Takano 1994). Kikuchi (1984) estimated that the formation of northwest Tama Hills is delta. The upper Member of Inagi Formation was estimated as delta topset. Shirai and Imamura (2013) reported barrier island, estuarine and shoreface sediments from the upper Member.
We estimated the depositional-environments of Inagi Formation with a facies analysis. The top of sand layer from middle mud layer in Inagi formation divided to the estuary unit, barrier island unit, shoreface-foreshore unit, Bay-head delta unit. Therefore, it was estimated that a comprehensive barrier island system include these four depositional units as a “small” estuay whithin a “brood” back- barrier area. The estuary formed very broad bay accompanied by the barrier island overlying of the bay-head delta unit on the shoreface-foreshore unit implies that estuary and tidal-channel unite may have been formed.

Keywords: Facies analysis, Kazusa Group, Inagi Formation, estuary

Holocene Landform Evolution at the South of Lake Idku, Northwest Nile Delta, Egypt, Reconstructed from Settlement Location and Sediment Cores

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1. Background & Objective

The Nile Delta has been formed in the mouth of Nile River, northern Egypt. It is said that Nile Delta started to be formed at 7,000 yr BP when due to the decline of the speed of the worldwide sea-level rise in post-glacial age sediment supply carried by river was piled in the depositional space (Stanley and Warne, 1994). And in the case of Nile Delta, sea-level has been still rising in 1,000-year order and now it's highest since post-glacial age caused by a compressive settling of delta deposits (Warne and Stanley, 1993). Besides it is a zone of arid environmental conditions called desert climate. Therefore, Nile Delta has been modified complicatedly by various forms of depositions; fluvial, marine and aeolian. So it is significant to examine the micro-topography using higher resolution.

This study focused on specific site and aimed to reconstruct landform evolution from analysis of three sediment cores drilled by Cairo Univ. in 2012 and settlement location.

2. Study Sites & Methods

This study focused on the site of Lake Iduk in the east of the Rasheed branch. There is a Roman archaeological site named Kom al-Diba'a in low land in the south of Iduk. It's located two slightly elevated flat hills which are about 6~8m high and 150~300m across. In this thesis the following methods were used ; landform classification by satellite photography using GIS software, field investigation of the study site, sedimentary facies analysis, soil color analysis, magnetic susceptibility analysis, grain size analysis, elementary analysis, 14C dating.

3. Result & Discussion

Geomorphology and Geology of Kom al-Diba'a

By investigation of Kom al-Diba'a outcrop and sample analysis; magnetic susceptibility analysis and grain size analysis, it is found that two slightly elevated flat hills are eolian sand dunes consisting of well-sorted medium~fine sand. Besides, the upper part of the south hill's outcrop is alternation of sand and silt which is assumed to be flood deposits.

Geomorphological Changes in the area of Lake Iduk

As a result of analysis about a sediment core drilled in former lagoon site of Lake Iduk, it can be divided into the following three stages and estimated sedimentary age; AB-boundary: 3000~4000 yrBP, BC-boundary: 1500~2000 yrBP. Thus, geomorphological changes in the area of Lake Iduk were reconstructed by these three stages. Thus, geomorphological changes in the area of Lake Iduk were reconstructed by these three units.

A: Iduk was connected to the Mediterranean Sea as a gulf. It was a depositional situation by inflowing of beach ridge sediments due to waves or small transgression and of flood deposits transported by the Nile. (Sand layer and element fluctuation)

B: Iduk was expanding especially to the east side caused by a compressive settling of delta deposits and flooded land area reduced in consequence. (Reduction of sand layer and element fluctuation)

C: Iduk was unconnected to the Mediterranean Sea due to beach ridge sediments transported from the mouth of Rasheed branch by coastal current. (Decline of sulfur concentration)

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Keywords: Egypt, Nile delta, archaeology, sediment core, Holocene, topography

