Short-term fluctuations in local radiocarbon reservoir age reconstructed from corals in the Ryukyu Islands

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High-resolution radiocarbon (^{14}C) dating is required in palaeoclimatology, palaeoseismology and archaeology. However, previously reported local reservoir age (ΔR) values have discrepancies in the Kuroshio region, which makes problems when accurately calibrating ^{14}C ages to calendar ages of marine samples. We measured radiocarbon dating of *Porites* corals from Ishigaki and Kikai Islands, which lie within the path of the Kuroshio Current off southern Japan, to determine local reservoir effect there. We found that the average ΔR from 1947 to 1950 for samples from Ishigaki Island was −36.0 years, which is consistent with the average ΔR value from 1901 to 1948 that we obtained for samples from Kikai Island. On the other hand, high-resolution ΔR data from Ishigaki Island for 1947 to 1950 fluctuated over a range of more than 150 years, from −136 ±42 to 62 ±50 years. Our compilation of new ΔR data and previously published data from the western Pacific indicates a strong positive-to-negative shift in ΔR during the period from 1900 to 1950. This shift of the local marine reservoir effect will affect calibration of ^{14}C ages to provide calendar dates in the Western Pacific.

Keywords: Radiocarbon, Corals, western Pacific, local marine reservoir age

Floodplain evolution in the Shiribeshi-toshibetsu River lowland, Hokkaido

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Low-gradient, fine-grained floodplains generally evolve by aggradation of fluvial deposits such as overbank deposits and crevasse-splay deposits. Therefore, the depositional history of these deposits has attracted much attention in studies of fluvial geomorphology and geology. However, few studies have constructed detailed chronologies of floodplain evolution, and the influence of sea-level and climate changes at submillennial time scales is not clear. This study investigated the Holocene evolution of the floodplain in the Shiribeshi-toshibetsu River lowland, Hokkaido, and reveals the impact of sea-level and climate changes on the floodplain evolution.
The Shiribeshi-toshibetsu River has a catchment area of approximately 720 km^2, and its current length is about 80 km. The floodplain of the Shiribeshi-toshibetsu River is about 2 km wide, and its northern and southern edges are bordered by uplands and terraces. Oxbow lakes are common in a well-defined meander belt near the present channel, and there are six large peatlands outside of the meander belt. The peat are 3–6 m thick.
Thirteen sediment cores were collected from four peatlands with a hand auger that recovered sediments from depths of up to 5 m and samples were collected at intervals of 5 cm. Loss on ignition was measured at intervals of 10 cm to quantitatively classify peat and organic-rich mud. Radiocarbon dating was conducted on plant and wood fragments and twigs using accelerator mass spectrometry. Two cross sections were constructed from existing columnar sections to show the stratigraphy beneath depths penetrated by hand augers.
The auger cores and cross sections demonstrate that thick and laterally continuous peat beds overlying fluvial deposits predominate in the uppermost part of the Holocene deposits. These relatively coarse deposits in an aggrading floodplain are likely natural levee deposits or crevasse-splay deposits, and the abandonment of crevasse splays and natural levees may have led to the peat formation. A radiocarbon age suggests that the peat initiation locally predates 6500 cal BP. Peatlands continued to expand until they reached their greatest extent at ca. 4000 cal BP. The similarity of peat onset ages at some sites in different areas suggests that a strong allogenic control reduced fluvial activity and led to the abandonment of crevasse splays and natural levees at ca. 5300–5000 and 4100–3900 cal BP.
The two periods of peat initiation at ca. 5300–5000 and 4100–3900 cal BP may correspond to decreases in precipitation from the weakening of the East Asian summer monsoon (EASM) at ca. 5600–5000 and 4000–3500 cal BP. The decreases in precipitation from the weakening of the EASM have been reported from many stalagmite records. Furthermore, decreases in the strength of the EASM at these times have been inferred from pollen records and lake-level records from multiple proxies. The continuation of peat accumulation after 4000 cal BP is consistent with the decreased precipitation after the events. Therefore, decreased precipitation may have reduced the water discharge from the upstream catchments, which in turn may have resulted in the abandonment of crevasse splays and natural levees. A similar fluvial response in the Ishikari lowland, Hokkaido, has been attributed to the weakening of the EASM.
On the other hand, the evidence in this study indicates that peatlands were moderately widespread before the inferred weakening of the EASM. In general, rapid sea-level rise during the early Holocene induced rapid aggradation of coastal floodplains through frequent crevassing and avulsion. Therefore, it is considered that aggradation slowed along with the pace of sea-level rise after ca. 7000 cal BP. The local peat initiation before 6500 cal BP in the lowland may be strongly associated with the deceleration of

sea-level rise.

Keywords: floodplain, peat, sea-level change, climate change, East Asian summer monsoon, Holocene

Environmental change from diatom analysis since MIS7~MIS8 in the Omoikawa lowland, the Kanto plain

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Omoikawa core(N36°14’ 51.19” E139°41’ 59.4”, 14.75m above sea level) was taken from the Omoikawa lowland ,located just the northern side of Watarase Basin.
The core, 60 m long, is composed of 3 sand and mud layers (A,C,E) and 3 gravel layers (B,D,F), as A to F from the top to the bottom.
From Unit A, two ^{14}C ages in Holocene were obtained. Diatom analysis for Unit A indicated freshwater environment.
Diatom analyses for Unit C showed mainly inner bay environment, along with marine to brackish tidal environments. It is supported by sulfur analysis. Unit C is probably correlated to MIS5e.
Unit D, gravel layer below Unit C, may be MIS6.

Keywords: diatom analysis, Omoikawa

Tephrochronology of the lowest Kazusa Group distributed in the Boso Peninsula, Chiba Prefecture , Japan

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The Kazusa Group distributed in the Boso Peninsula, Chiba Prefecture, Japan.
In order to characterize the tephra layers with in the lowest Kazusa Group, authors investigated the thickness, color, shape of volcanic glass, mineral composition, refractive index of volcanic glass and the majer and trace element composition of volcanic glass. Two tephra layers in the Namihana and the Katsuura Formation of the lowest Kazusa Group can be correlated with tephra layers of the other Plio-Pleistocene Groups in central Japan. The KW1 and KW2 tephra layers in the lowest Kazusa Group are correlated with the Jwg3-Okr10 tephra(2.388 Ma) and Fup-OK2 tephra(2.2-2.3 Ma). The age of the lowest Kazusa Group is about 2.4 Ma by these tephra correlations.

Keywords: Kazusa Group, Age, Namihana Formation, Katsuura Formation, Widespread tephra correlation, Tephrochronology

Correlations of the Takeyama-Ks10 and Hegawa-Ks5 tephras, two Middle Pleistocene widespread tephras derived from southern Kyushu, SW Japan

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This study shows the correlations of the Middle Pleistocene widespread tephras derived from southern Kyushu, southwest Japan. Two Middle Pleistocene widespread tephras referred to here as Takeyama-Ks10 (Tkym-Ks10) and Hegawa-Ks5 (Hgw-Ks5) have been newly recognized.
The southern Kyushu caldera region composed of the several large calderas, located in southwest of the Japanese islands, is one of the most active volcanic regions providing voluminous widespread tephras. Eight widespread tephras have been reported from the southern Kyushu caldera region since 1 Ma. Five of them occurred in a cluster after the eruption of the Kakuto tephra (330–340 ka). Compared with the tephras of the Late Pleistocene to Holocene, widespread tephras of the Early to Middle Pleistocene ages have not been well studied. On the other hand, four widespread tephras (Ks18, Ks11, Ks10 and Ks5, in ascending order), which are thought to derive from southern Kyushu, are intercalated in the Kasamori Formation of the Kazusa Group, in Boso Peninsula, central Japan. Among them, Ks10 and Ks5 have uncertainties of identification and their correlations as a widespread tephra. Although Ks10 and Ks5 are broadly recognised in southwest to northeast Japan as distal ash fall deposits, the proximal pyroclastic flow deposits (PFDs) of Ks10 and Ks5 has not yet been determined in Kyushu Island. Moreover, there are petrographically similar tephras to these two tephras, which leads to difficulties and mistakes in the widespread correlation.
In southern Kyushu, we newly defined two PFDs: Takeyama (Tkym) and Hegawa (Hgw) PFDs, in ascending order. Tkym and Hgw are stratigraphically above the Kb-Ks tephra (Kb-Ks). Based on the petrographic properties including the glass chemistry, we examined their correlations with Ks10 and Ks5. Tkym-Ks10 was identified using a combination of refractive indices and major element chemical composition of glass shards (n=1.498-1.501, SiO_2: 78.3-78.6 wt.%, TiO_2: 0.2-0.3 wt.%, Al_2O_3: 12.2-12.4 wt.%, FeO: 1.0-1.1 wt.%, CaO: 1.1 wt.%, K_2O: 2.9-3.0 wt.%, Na_2O: 3.4-3.6 wt.%) and mineral assemblage composed of abundant hornblende and few biotite and quartz. On the other hand, Hgw-Ks5 was identified using a combination of refractive indices and major element chemical compositions of glass shards (n=1.504-1.506, SiO_2: 77.2-77.5 wt.%, TiO_2: 0.3-0.4 wt.%, Al_2O_3: 12.6-12.7 wt.%, FeO: 1.4-1.5 wt.%, CaO: 1.3-1.4 wt.%, K_2O: 2.9-3.1 wt.%, Na_2O: 3.4-3.7 wt.%) and mineral assemblage composed of orthopyroxene and relatively few hornblende.
Based on previous isotope stratigraphy studies, the eruptive ages of Tkym-Ks10 and Hgw-Ks5 are 480–530 ka (MIS 13) and 430–450 ka (MIS 12), respectively. The apparent volume of each tephra estimated from the distribution area and thickness of the co-ignimbrite ash fall deposits (CAFD) is approximately > 100 km^3, assuming that each CAFD originating from the Aira Caldera is distributed concentrically. Therefore, a Volcanic Explosivity Index (VEI) of 7 was assigned to the eruptions. Eight widespread tephras derived from the southern Kyushu caldera region during the last 600 ka, Smkd-Ks18 (part of former Hwk), Kb-Ks, Kkt, Ata-Th, Ata, K-Tz, AT and K-Ah tephras, in ascending order, had been reported. This indicates that eruptions accompaning huge pyroclastic flow deposits (VEI 7) occurred at an average interval of about 75 kry as the whole Kagoshima Graben. However, considering two newly defined widespread tephras Tkym-Ks10 and Hgw-Ks5 positioned between Kb-Ks (530 ka) and Kkt (340 ka) from Kb-Ks to Kkt eruptions, the frequency of large caldera eruption (VEI 7) through the past 600 ka was

revised to once in 60 kyr on average. In addition, focusing on the eruption interval in detail, the interval has changed at Hgw-Ks5 eruption. During the period of 500 kyr from Smkd-Ks18 eruption to Ata eruption (105 ka), the average interval of large-scale eruption in the Kagoshima Graben had become longer from 40 to about 100 kyr after the Hgw-Ks5 eruption.

Keywords: widespread tephra, Middle Pleistocene, correlation, southern Kyushu, Kasamori Formation

Dawson Tephra in the sedimentary core collected at the Patton Seamount, off the Alaska Peninsula

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This study reports tephras in the giant box core SO202-27-6 collected at the Patton Seamount off the Alaska Peninsula during the research cruise SO202-INOPEX in 2009. It was collected on the Patton Seamount at the latitude 54°17.77’ N, the longitude 149°36.01’ W and the bottom of the sea which is 2919 m. The core consists of the pelagic ooze, and its length is 2.92 m. There are two tephra layers, which the upper layer (Sample ID93 and ID94) is sub bottom depth 119-122 cm and the lower layer (Sample ID95) is sub bottom depth 135-138 cm. ID93 tephra sample is well-sorted and normal grading whitish gray volcanic ash layers which maximum diameter of grain size is approximately 3 mm, and including some lithic fragments which diameter is about 9 mm. ID95 tephra sample is crystal rich layer including fine volcanic glass shards.
Electron microprobe analysis determined the major element composition of volcanic glass shards in ID93 tephra sample. Geochemistry of ID93 tephra is rhyolite and very similar to Dawson tephra (ca. 27 ka) in Mangan et al. (2003). Furthermore, geochemistry of ID93 tephra sample determined by the X-ray fluorescence is also close to geochemistry of whole-rock analysis of pumices (Mangan et al., 2003). Dawson tephra was provided from the Emmons Lake volcano on the Alaska Peninsula in the last glacial maximum, and found in loess deposits on west-central Yukon Territory. This is the first discovery that Dawson tephra distributes over the Pacific Ocean.

Mangan et al. (2003), Emmons Lake Volcanic Center, Alaska Peninsula: source of the later Wisconsin Dawson tephra, Yukon Territory, Canada. Canadian Journal of Earth Science, 40, 925-936.

Keywords: Dawson tephra, the Alaska Peninsula, sedimentary core

The world’s OLDest pottery and stone arrowheads appeared in the cOLD est climate in the cOLD area in Japan

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The first emergence and development of pottery is an important archaeological research topic. Climate change and the associated ecological changes likely promoted the development of pottery. However, little is known about these environmental factors at regional scale. Sedimentary core MD01-2409 collected off the coast of northern Honshu, Japan, provided a good opportunity to quantitatively estimate paleo-temperatures using the alkenone proxy because of the positive correlation between atmospheric and sea surface temperatures. The earliest pottery found in Japan was excavated at the Odai-Yamamoto I site and its age was approximately 15.5-16.5 thousand calendar years before present (cal. kyr BP), when the climate on the island was the coldest one which the Jomon people had experienced due to weakened the Asian Summer Monsoon influenced by one of the global effects of Heinrich Event I. The atmospheric temperature was approximately 7~11˚C lower than it is currently, which was a little colder than those at present-day Nemuro and/or Nosappu cities in Hokkaido. Subsistence in a terrestrial environment and plentiful marine products such as fishes and shells are consistent with the evidence that the earliest pottery was predominantly used for cooking marine and freshwater resources and increased diversification in the range of aquatic products used. Although the relationship between climate and the appearance of pottery in Japan may not be direct, the earliest pottery and projectile points (stone arrows) in the world are associated with the coldest period that Homo sapiens experienced since arrive in very cold region of the Japanese archipelago.

Kawahata, H., Ishizaki, Y., Kuroyanagi, A., Suzuki, A., Ohkushi, K. (2017) Quantitative reconstruction of temperature at Jomon site in the Incipient Jomon period in northern Japan and its implication for the production of early pottery and stone arrowheads. Quaternary Science Reviews, 157, 66-79.

Keywords: Sea surface temperatures, Atmospheric temperatures, Climatic change, pottery, stone arrowheads, Jomon people

Human adaptations to alpine landscape during 30-19 ka: exploitation of obsidian sources in the Last Glacial Maximum

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The paper focused on the human-environment interaction between climatic impacts of the Last Glacial Maximum (LGM) and obsidian exploitation of the Upper Palaeolithic (UP) hunter-gatherers. The correlations were examined using three datasets. First, changes in obsidian use in the Chubu-Kanto region during ca. 38-19 ka were reconstructed by using ca. 80,000 obsidian sourcing data assigned to cultural horizons in the UP chronology. Second, how changed site distribution patterns during the UP in the obsidian source area of Central Highlands 1200-1400 m were described. Finally, chronological control was established by means of calibrated radiocarbon dates between palaeoenvironmental record for the past 30,000 years obtained from the Hiroppara bog situated 1400 m in the Central highlands (Yoshida et al., 2016) and the archaeological record mentioned above. To compare these datasets, four periods divided into before 30 ka, 30-25 ka, 25-20 ka, and 20-19 ka were adopted.
Results are as follows. (1) The use of Central Highlands obsidian in the Chubu-Kanto region before 30 ka shows the highest percentage, while the use frequency suddenly declines during the early LGM 30-25 ka. The pollen record (pollen accumulation rate for tree: PARt) during 30-25 ka clearly indicates that the tree line retreated below 1400 m and the alpine landscape prevailed in the source area. No sites are distributed in the area, indicating human activities for stone tool production were very sparse. (2) Pollen record in the LGM cold phase 25-20 ka shows that the tree line remains descended below 1400 m and the climatic condition in the alpine landscape gradually deteriorated from 25 ka to 20 ka. A number of large-sized lithic industries, however, are distributed in the alpine landscape, indicating vitalization of obsidian procurement and stone tool production in the area. (3) The tree line gradually ascended during 20-19 ka and reached above 1400 m by 17 ka, reflecting climatic amelioration in the deglaciation period. In spite of warming, the number of sites in the alpine landscape decreased and the use frequency of the Central Highlands obsidian in the Chubu-Kanto region also declined. In contrast, the use of obsidian from the Kozu Island transported by seafaring suddenly increased and competed with that of the Central Highlands obsidian. Additionally, the distribution of the Central Highlands obsidian clearly prevailed in the northern half of the Chubu-Kanto region, while that of the Kozu Island obsidian heavily biased in the southern half of the region.
Human adaptations during 30-19 ka to the alpine landscape in the source area of Central Highlands show a complex history. In the early LGM 30-25 ka, the climate deterioration and the decrease in frequency of access to the Central Highlands show a strong correlation. In this period, the exploitation of the Hakone and the Izu-Amagi source areas where the sources were located in lower altitudes was preferred. The hunter-gatherer groups during 25-20 ka, however, actively exploited the alpine landscape where the cold and dry climate still dominated. Cultural adaptations such as skills for occupation in the alpine landscape were likely improved. In 20-19 ka, the sudden increase in the use of Kozu Island obsidian strongly implies that the emergence of the northern regional group mainly exploiting the Central Highlands for obsidian procurement and the southern regional group preferred to use the Kozu Island obsidian. Accordingly, the development of forest landscape in the Central Highlands after 20 ka was not likely related to the obsidian use dynamics. Instead, the societal change impacted on human activities for the natural resource exploitation.

Yoshida, A., Kudo, Y., Shimada, K., Hashizume, J. and Ono, A. 2016 Impact of landscape changes on

obsidian exploitation since the Palaeolithic in the central highland of Japan. Vegetation History and Archaeobotany, 25: 45-55.

Keywords: obsidian exploitation, Upper Palaeolithic, human-environment interaction

Vertical changes of tree-line and site distribution: a case of early Mesolithic in northern Tyrol, Austria

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The presentation focuses on correlation between 1) palaeoenvironmental changes expressed on ice sheet regression and site distribution, and 2) vertical changes of tree-line and site distribution in the early Mesolithic in northern Tyrol in Austria. Ullafelsen open air site (ca. 112,000 - 10,650 cal yrBP) is located in high mountain of Fotcher valley, Stubai Alps. Excavations have revealed that at least two different cultural traditions such as Beuronian from southern Germany and Sauveterrian from northern Italy in exactly co-existed archaeological contexts. Many lithic raw materials have also identified i.e.; flint from southern Alps, rock crystal from central Alps, radiolarite form northern limestone Alps, and hornstone from Franconian Alp (Bavaria). These materials indicated high mobility of early Mesolithic people, and they had much more wide range exchange network than the later phase of Magdalenian groups in the upper stream area of Danube river. This means the early Mesolithic people had extended their activity to the wide area that had been performed after retreatment of the ice sheet from the right bank of Danube river to the northern Tyrol. Vertical rise of climate-induced tree-line and site location have relatively strong causal relationship, and this pulled up the location of Mesolithic sites, because of their hunting strategies for Alpine Ibex (*Capra ibex*) etc., that they are favorable to inhabit at tree-line zone. These phenomena indicate a dynamic correlation between natural resource environment and human adaptations.

Keywords: northern Tyrol , Ullafelsen site, early Mesolithic, tree-line, site location

Geologic attractiveness of the Zagros Mountains for early humans

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The Zagros Mountains of Iran, which culminate in Mt. Zard (4548 m), formed along the convergent boundary between the colliding Arabia and Eurasia plates during late Miocene to early Pliocene time. The range consists almost entirely of limestone. Recently, the Zagros Mountains have yielded key evidence of the expansion from Africa of Homo sapiens, which originated in East Africa 200,000 to 100,000 years ago. There are two main routes from Africa to Eurasia, a northern route from the Sinai Peninsula to the Levant and a southern route around the Arabian Peninsula. Because recent research in Iran has documented Paleolithic remains from before 50,000 years ago at Arsenjan, northeast of Shiraz, the southern Zagros Mountains have received attention for their role in the southern route of early human migration. Early humans who followed this route onto the Eurasian continent would have confronted the Zagros Mountains immediately. This situation, however, was so fortunate for them that the Zagros Mountains became a starting point for the spread of humans to the rest of the world. Raw material for stone tools was easily available in the form of radiolarite (chert), and the abundant limestone caves served as ready dwellings near the radiolarite outcrops. This limestone-radiolarite association that characterizes the Zagros Mountains provided superb conditions for these ancient people. This association also occurs elsewhere in Western Asia and in the Mediterranean region. The objective of this study was to determine what geological factors in the Zagros Mountains brought benefits to the first humans coming out of Africa. During the Jurassic, the continents of Laurasia and Gondwana were separated by the shallow Neotethys Ocean. Present-day western Asia was located at the innermost part of the Neotethys near the paleo-equator at a favorable location for upwelling currents, resulting in high faunal productivity. Thus, an extensive carbonate platform developed on the Arabian continental margin. After the Arabia plate separated from the Africa plate and collided with the Eurasia plate, the limestone-radiolarite association was folded and uplifted to form the Zagros Mountains. Here came to be a land replete with limestone caves and widespread radiolarite that welcomed ancient Homo sapiens.

Keywords: Zagros Mountains, Stone tool, radiolarite

A natural disaster can be a factor of landscape change? –with special reference to Lake Kitagata in Awara, Fukui, Japan

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The change of landscape might be caused by the combination of climate change, human activities, natural disasters, etc. Many human activities transformed the landscape during historical period. Lake Kitagata is located in Japan Sea coastal area, central Japan, and is surrounded by sand hill, coastal terrace and flat plain. Many archaeological sites including a salt production site are distributed around the areas. In the flat plain, major land transformation to agriculture is recorded in the early 12th century AD. Considering the impact of tsunami in Tohoku area, natural disasters have also influenced the surrounding vegetation and landscape. Several tsunamis were recorded in Japan Sea coastal area during historical period, and the Tensho Tsunami which might influenced the area occurred in AD1586. A crop failures and consequent peasant uprising due to salt damege and typhoon was also recorded in AD1712. However, the damages from them are unknown. Five sediment cores were recovered from Lake Kitagata.We sub-samplesd for pollen analysis from three cores, and analyzed the samples, in order to reveal the landscape change around Lake Kitagata.
Based on the pollen analysis, the land including plain area were covered with dense forests of evergreen oak and *Castanopsis*. Salt making caused a deforestation in plain area and around the 12th century when land transformation to agriculture occurred, paddy fields seems to be developed in the deforested area for salt making around Lake Kitagata. Buckwheat has been cultivated intensively since the late 13th century AD when the Little Ice Age started in Japan. The development of pine forests dates back to around the 17th Century AD. Before this, the area was spotted with few trees especially in plains and ferns grew thickly in the river mouth of Daishoji River. It seems that the surrounding vegetations have transformed to Japanese cedar and evergreen forests recently.
During this succession, natural disasters seemed to change the vegetation. One may be in response to Tensho Tsunami in 1586. Almost all pollen taxa decreased but *Pinus* subgen. *Diploxylon*. In this time, salt damage might not happen since Chenopodiaceae which has salt tolerance did not increase. Another one was observed in the late 17th century AD. It seems that the vegetation was damaged by salt. Large amount of Chenopodiaceae pollen was observed in this period. A peasant uprising which was caused by crop failures due to salt damege and typhoon was recorded in AD1712. However, the vegetation was soon recovered. Although an impact from disasters on vegetation was observed, it did not last long. Human activities and climate seems to be much bigger factors.

Keywords: pollen analysis, vegetation, disaster

Relation between with distribution of liquefaction-fluidization phenomena at the 2011 off the Pacific coast of Tohoku Earthquake and distribution of the Holocene strata

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Liquefaction-fluidization phenomena distributed widely on the reclaimed land around northern Tokyo bay at the 2011 off the Pacific coast of Tohoku Earthquake. Sand-volcanoes by liquefaction-fluidization distributed on belts with 500m wideth in the reclaimed land from Ichikawa city to Chiba city. Continuous boring cores were taken and shear wave velocities were measured on Gyotoku high school in Mamagawa belt and Funabashi-Minato junior high school in Ebigawa belt. Sand-volcanoes distribute almost on paleo-valley at the last ice age around the survey sites.
Strong waves were simulated by SHAKE method on strong motion data in Shimosa Group at reclaimed land in Chiba city at the survey sites in the paleo-valley and out of the paleo-valley, neighbor sites.
On Mamagawa belt, JMA intensity 6- in the paleo-valley and 5+ out the paleo-valley were calculated. On Ebigawa belt, JMA intensity 5+ in the paleo-valley and 5- out the paleo-valley were calculated.

Keywords: the 2011 off the Pacific coast of Tohoku Earthquake, liquefaction-fluidization, Tokyo bay reclaimed land, Man-made strata, Holocene strata

Consideration for marine alluvium in Bisan-Seto, Seto Inland Sea. –by re-examination of seismic profiles-

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Re-examination of stratigraphy of so called alluvium all over Japan has been in progress. Investigations at alluvial plains are mainly based on analysis of drilled samples. On the other hand, so called marine alluvium has not yet been re-examined up to the present. Marine alluvial stratigraphy around Bisan-Seto at the central part of Seto Inland Sea is focused this time. As a result of re-examinations based on seismic profiles acquired by Bubble Pulser (Boomer) system, a new acoustic reflector is identified in marine stratum of upper portion of alluvium. This reflector divides upper sandy layer that forms sand bank in present marine sedimentary condition and lower muddy layer, and it reflects environmental change caused by the formation of strait between eastern Bisan-Seto and western Bisan-Seto (or the formation of straits lying between islands). This is the largest environmental change of Bisan-Seto caused by sea level rise after the end of last glacial period. Bay muds are distributed beneath the reflector, and sandy sediments which deposit under the influence of tidal current are distributed above the reflector.

Keywords: alluvium, Seto Inland Sea, seismic profiles

Geomorphological Evolution of Hashirikotan barrier spit controlled by Seismotectonics along the Southern Kuril Subduction Zone

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The Hashirikotan barrier spit is active in the northeastern part of Furenko lagoon facing the Nemuro Strait because five branches of spits (BS1~BS5) are clearly observed and dated by tephrochronology. The Hashirikotan barrier system has been established since 5.5 ka. The youngest BS1 has occurred after the 17th century and BS2 caused by the last seismic up rifting in the 17th century. BS3 rifted in the 12~13th century. BS4 caused by the seismic up rifting in the 9th century. BS5 has occurred at 4 ka. Since 2003, it was clearly that the great earthquakes (Mw8.5~9.1) have been occurred at an interval of 500 years along the southern Kuril subduction zone. Especially coastal area raised almost 1~2m just after the great earthquakes due to the post seismic displacements. But conversely land subsidence has been continuing at a rate 1.0 mm/year since the 17th century until now. We express that geomorphological evolution of the Hashirikotan barrier system has been controlled by the seismotectonics along the Kuril subduction zone.

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Keywords: geomorphological evolution, Hashirikotan barrier spit, seismotectonics, southern Kuril trench, eastern Hokkaido

Effects of valley topography on run-up of the 2011 Tohoku tsunami on the Sanriku coast, northeastern Japan

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The 2011 Tohoku earthquake and tsunami caused heavy damage in low-lying valleys of the Sanriku coast, northeastern Japan. The landward extent of inundation by the tsunami varied considerably among the river valleys, indicating that tsunami run-ups were strongly affected by the subaerial fluvial morphology of the valleys. We used detailed tsunami inundation maps to investigate tsunami run-ups along river valleys along the Sanriku coast, considering both the protected areas landward of coastal seawalls and levees (protected zone), and areas riverside of levees (channel zone). We compiled detailed longitudinal river profiles and used them in conjunction with published tsunami inundation maps to determine the distances and heights of tsunami run-ups in 68 valleys along the Sanriku coast. Run-up heights tended to be higher and run-up distances longer in the channel zone than in the protected zone. Comparison among valleys of run-ups with longitudinal valley slopes showed that run-up distances decreased with increasing valley slopes, and that run-up heights increased with increasing slopes. Further studies of the effects of subaerial fluvial morphology and friction on tsunami run-ups, and the influence of tsunami wave height, are needed to improve our interpretation of paleo-tsunami deposits in Quaternary sediments and improve future tsunami-disaster prevention programs.

Keywords: 2011 Tohoku earthquake, Sanriku coast, Tsunami run-up, Narrow valley floor, Longitudinal valley profile, Tsunami inundation map

Holocene sedimentary succession and crustal movement in the Tsugaruishi plain, central Sanriku coast, northeast Japan

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Along the Sanriku coast, discrepancies in crustal movement (10^5 year scale uplift and 10^1 –10^2 year scale subsidence) have been reported between long (10^4–10^5 years) and short (10^1–10^2 years) timescales. Well-dated Holocene incised valley sediments provide records of millennial-scale vertical crustal movement, which is a key to understand the tectonic history in this area. Recent study of the age and distribution of early Holocene intertidal deposits in the incised valley suggested that the southern Sanriku coast has subsided during the Holocene with an average rate of about 1 mm/yr. Here we studied three sediment cores collected from the Tsugaruishi plain, on the central Sanriku coast.
A typical Holocene deltaic succession was recognized in both three cores; basal gravel of alluvium, flood plain or estuary sand and mud, inner bay mud with subtidal molluscan shells, deltafront sand layer with upward coarsening successions, and modern fluvial sand, mud, and gravel layer, from lower to upper. In the upperstream site, sand and mud layer with finning upward succession is identified just above deltafront sand layer with coarsening upward succession. This sand mud layer contains in situ intetidal molluscan shell, indicating intertidal deposition. Thus, elevation of this intertidal sediments (ca. -12 m relative to present sea-level) approximates paleo-sea level at the timing of deposition (ca. 7500 cal BP). Along the Pacific coast of northeast Japan. RSL at 8000 to 7000 cal BP is estimated to be higher than -5 m relative to the present sea level (Okuno et al., 2014). Thus, middle Holocene intertidal deposits at ca. -12 m relative to the present sea-level indicates Holocene subsidence trend along the Tsugaruishi plain as estimated along the southern Sanriku coast.

Keywords: Holocene, Sanriku coast, crustal movement

Study of shallow subsurface geology based on analysis of sedimentary cores drilled in 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. AIST, 2007). Quaternary geological structure of the Aizu basin and tectonic histories of both fault zones are still not clear because of lack of chronological studies of underground sediments of the basin, except Suzuki et al (2013, 2016) discussed tephrochronology in the basin and activity of the West Aizu Basin Fault Zone since middle-Pleistocene based on analysis of a sediment core (AB-12-2, 179.1m asl, 99.5m depth) drilled in the western part of the basin.

AIST drilled two sediment cores (GS-SOK-1, 175.99m asl, 130m depth; GS-AZU-1, 208.36m asl, 100m depth) in the eastern part of the Aizu Basin and reported their stratigraphy based on tephra and fossil pollen analysis (Ishihara et al., 2015, 2016). In this report, we discussed a shallow subsurface geology by correlating each stratigraphy of GS-SOK-1, GS-AZU-1, and AB-12-2 cores.

2. Geogical stratigraphy of cores in the Aizu Basin

GS-SOK-1: Sn-SK tephra (220ka, Suzuki et al, 2004) is included in the depth of 81.1-81.7m. Twelve local pollen assemblage zones (SOK-I, -II⋯, and –XII, in ascending order; added to Ishihara et al., 2016) are divided. Tertiary flora (e.g. *Metasequoia*, *Keteleeria*, *Carya*) are slightly included in SOK-I zone (111.1-126.7m depth; Ishihara et al., 2016). On the basis of tephra, pollen, and 14C analysis, we divided stratigraphy of GS-SOK-1 into the following: Holocene (0.0-6.0m depth), upper Pleistocene (6.0-45.0m), middle Pleistocene (45.0-110.5m), and lower Pleistocene (110.5-130.0m).

GS-AZU-1: Five tephra layers are identified as follows (depth: tephra neme and age), 13.35-13.38m: AT (29-30ka, Machida, 2011), 30.25-30.30m : Aso-4 (87ka, Aoki *et al.*, 2008) , 34.10-35.10m: Nm-SB (110ka, Suzuki et al, 2004) , 52.35-52.40m: Sn-MT (180-260ka, Suzuki et al, 2004) , and 70.5-76.3m: Kachikata ignimbrite (one of the Shirakawa ignimbrites; Yoshida and Takahashi. 1991; Kurokawa *et al.*, 2008). On the basis of tephra and 14C analysis, we divided stratigraphy of GS-SOK-1 into Holocene (0.0-5.0m depth), upper Pleistocene (5.0-36.5m), middle Pleistocene (36.5-52.5m), and lower Pleistocene (52.5-100.0m).

AB-12-2: On the basis of Suzuki *et al* (2016), geological stratigraphy of AB-12-2 is divided into Holocene (0.0-ca. 8.5m depth), upper Pleistocene (ca. 8.5-44.5m), and middle Pleistocene (ca. 44.5-99.5m).

3. Shallow subsurface geology in the Aizu Basin

Accumulation rate of the sediments at GS-AZU-1 are 0.45m/kyr between ground surface and AT, and 0.26-0.27m/kyr between AT and Nm-SB, whereas the accumulation rates of AB-12-2 (Suzuki *et al.*, 2016) are 0.46-0.55m/kyr between ground surface and DKP (55-66ka; Suzuki *et al.*, 2016), and 0.19-0.23m/kyr beween DKP and TG (129ka; Aoki *et al.*, 2008). Similarity of accumulation rates between GS-AZU-1 and AB-12-2 indicates that vertical average slip rate of the East Aizu Basin Fault Zone is comparable with rate of the West Aizu Basin Fault Zone if the accumulation in the basin corresponds to the activity of both fault zones. Difference in changing period of accumulation rate implies time lag of each fault activity and/or local variation of sedimentary environment.

Boundaries between lower and middle Pleistocene in the Aizu Basin are, at 50-60m depth in Aizu-Wakamatsu, 110-120m in Shiokawa, 50-60m in Atsushio (Tohoku METI, 1999) from south to north, indicating structure of lower Pleistocene inclining toward central basin from south and north margin. By contrast, in Aizu-Bange, western part of the basin, stratigraphy of AB-12-2 (Suzuki *et al.*, 2016) and well columns indicates lower Pleistocene lies below 100-150m depth, showing incline westward of lower Pleistocene. These results are important to clear tectonic histories of both fault zones.

Keywords: Aizu basin, Quaternary, Pleistocene, shallow subsurface geology, tephra, fossil pollen

Crevasse splay evolution and changes in depositional condition of surrounding floodplain inferred from surface deposits of the Kinu River, central Japan

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Crevasse splays are an important component of floodplains and have been suitable topography for human occupation through the prehistorical and historical times because of rapid, intensive aggradation of the specific area in floodplains which in turn produces relatively elevated place against following inundation events. However, more needs to be known about their morphology, time scales of formation, and relationships with surrounding floodplains to clarify the roles for floodplain evolution and human use of crevasse splays.
A crevasse splay diverted from the Kinu River at Obokawa, Joso City, Ibaraki Prefecture was reconstructed by analysis of several drilling cores (up to a depth of 5 m), coupled with ground penetrating radar (GPR) survey and radiocarbon dating. The study area is located 25 km upstream from the confluence of the Kinu River with the Tone River. The Kinu River in this area has a low sinuosity, single channel and a sandy bed with a gradient of about 1/2500. Sadakata (1971) suggests that overbank vertical accretion is dominant in the floodplain there, which is 4–8 km wide and is bordered on both the west and east by the Kinu and Kokai rivers.
The crevasse splay is about 2 m higher than surrounding flood basins, forming a convex-shaped mound. The splay and the trunk channel of the Kinu River were connected by a narrow crevasse channel. The crevasse splay experienced the development of new rice fields since 17th century, indicating the inactivity of the splay since then.
The facies of the cores were roughly divided into three depositional units composing channels (CH), natural levees (LV), and back swamps (BS). Core OBK-01, located in the crevasse channel, had two CH units at the depths of 1–2.5 m and 3–3.5 m, positioned above and below a BS unit. The radiocarbon age determined at Micro Analysis Laboratory, Tandem accelerator, the University of Tokyo suggests this repetitive channel emergence dated back to later than 1000 BC. Cores adjacent to the crevasse channel showed alternate deposition of BS and LV units in 0.5–2 m thick for each unit, indicating that the LV units were associated with development of the crevasse channel and the distribution of alluvial topography had frequently changed in the past. Detailed facies analysis, GPR profiles, and additional radiocarbon ages will be shown in the presentation.

Reference
Sadakata, N.: Formation of the Lower Kinu River Floodplain, Geographical Sciences (Chiri Kagaku), 18, 13–22, 1971 (in Japanese with English abstract).

Keywords: crevasse splay, floodplain, the Kinu River, ground penetrating radar

3D geologic modelling in the subsurface of the Tokyo Lowland : methodology and application

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This study demonstrates a 3D ground model of the coast plain in the Tokyo Lowland and the adjacent upland, using borehole log data (standard penetration test for engineering works). The borehole data are about 6000, digitized for modelling. The model area ranges from X: 387,000 –407,000m and Y: 3,944,400 –3,956,500m in the UTM 54 zone, and being composed of the coast lowland and the adjacent loam upland geographically. The 3D model is expressed with both the surface model of geologic boundaries and the 3D grid with attributes of N-value, lithology and geologic unit. The grid size is 100m in width, 1m in height. The detailed methodology refers to Eto et al.(2008) and Kimura et al.(2013, 2014).
The surface model consists of a geomorphic surface based on a digital elevation model (5m mesh) and the stratigraphic basal surfaces including the Holocene sediment (Chuseki-so), the fluvial terrace deposits, and the Middle to Upper Pleistocene Shimousa (Sm) Group, in descending order. The basal horizon of the Sm Group is close to the engineering base surface (more than 50 of N-value). The 3D grid model is constructed by horizontal interpolation of borehole data on each altitude with the inverse-distance weighting method and stacking vertically. The borehole data for modelling are subdivided into each geologic unit and the model calculation is performed for every subdivided geologic units.
The distribution pattern of the N-values and lithofacies in the 3D grid model demonstrates inner physical structure and sedimentary facies of ground such as basal gravel of the Chuseki-so, meandering-channel fills, and marine mud of inner bay. In addition, the 3D grid model offers a detailed renewable geologic model to calculate the S-wave velocity structure model for evaluating the seismic amplification properties.

Keywords: 3D geologic model, voxel model, borehole data, Tokyo Lowland, ground model

Environmental History during the last 2,000 years in Lake Hamana, Shizuoka

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Lake Hamana is seventh biggest lakes in Japan, locates on the coastline of the Pacific Ocean. Archaeological data suggests that people lived around the lake from Jomon periods, and brackish environment in the lake that is modern condition might be caused by tsunami event related to huge earthquake along the Nankai Trough in 1498 AD.
In order to reconstruct the variation of the past environment during the last 2,000 years, TOC, TN, TS contents with multiple radiocarbon data are measured with high-resolution.
The bottomed sediments were obtained at northern flat basin which is approximately 11 m in water depth in the lake. Two sediments cores which are 378 and 132 cm length, respectively have continues deposition since the 2,100 cal yr BP on the basis of radiocarbon data.
Our preliminary results of variations of TOC, TN, TS contents indicates brackish to marine environments last for the 2,000 years, and there is no signal against tsunami event in 1498 AD.

Keywords: Sedimentary Environment, Lake Hamana

Tephras from Tarumai volcano in Tonbetsu Plain, Northern Hokkaido,Japan

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Tarumae volcano is an active volcano that performs multiple volcanic activities from the beginning of the Holocene. Tephra of Tarumae volcano are Ta-a, Ta-b, Ta-c 2, Ta-d. They are distributed throughout Hokkaido. However, the Tonbetsu plains have few mention examples of tephra.
In this study, we analyzed it with an outcrop mention in Northern Hokkaido, Hamatonbetsu coastal area and examined tephra.
As a result it was estimated that two tephra layers distributed over the Tonbetsu plains were correlation of the Tarumai volcano.

Keywords: Tephra, Sand dune, Tarumai volcano, Tonbetsu plain, Holocene

MIS 5c key-maker tephras in the upper Pleistocene Joso Formation in the southern Sashima, Tsukuba and northwestern Shimosa Uplands, Kanto plain, Japan

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Most of the terraces in the Kanto Plain had been formed in marine oxygen isotope stage (MIS) 5 under the influence of eustatic sea-level lowering after MIS 5e and Kanto basin forming movement characterized by uplift of the marginal part and subsidence of the central part. It remains unknown how upper Pleistocene Joso Formation, Shimosa Group and terraces composed of the Joso Formation had been evolved after MIS 5e at the central Kanto Plain. This study classified terrace surfaces by the integration of geomorphic analysis, sedimentary facies analysis and tephra analysis focusing on the southern Sashima, Tsukuba and northwestern Shimosa Uplands in the central part of the Kanto Plain. Terrace surfaces were classified into 6 levels. The terrace sediments distributed over the 1 to 5 levels from the top in the Sashima Upland and 1 to 3 levels from the top in the Tsukuba Upland were divided into two formations; Kioroshi Formation composed of beach facies, and the Joso Formation composed of flood plain and channel facies. In the Joso Formation, we found two different tephras and correlated them to Nk-Ma (c. 100 ka: Yamamoto, 2012) at Tsukuba Upland and On-Pm1 (c. 96 ka: Aoki et al., 2008) at Sashima upland by element analysis of the volcanic glass and minerals.
Nk-Ma has been identified in the Naka, Kashima, Namekata, Nihari and Inashiki Uplands (Ooi, Ph. D, 2013).We identified Nk-Ma tephra in the Tsukuba upland for the first time. This indicates that the southern limit of Nk-Ma fall range becomes much wider than previous studies. Nk-Ma in the Tsukuba upland has 2 to 8 cm thickness, 12 mm maximum pumice size, light yellow color. It contains orthopyroxene, clinopyroxene, hornblende, brownish bubble-wall and grayish pumice type glass shards. It is expected to trace of Nk-Ma for other regions and to date of Joso formation with tephra including Nk-Ma.

References: Aoki *et al.* (2008) *The Quaternary Research*, **47**, 391-407. Ooi (2013, Ph. D) Doctoral thesis, Graduate school, Ibaraki University, 172p. Yamamoto (2012) *Bulletin of the Geological survey of Japan*, **63**, 35-91.

Keywords: Kanto Plain, Sashima Upland, Tsukuba Upland, Shimosa Upland, MIS 5c, Tephra

A discovery of Amagi-Kawagodaira tephra(Kg) from core samples taken at the connecting bar in Kushimoto, southern tip of Kii peninsula, Pacific coast of western Japan

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We report a new discovery of Amagi-Kawagodaira tephra(Kg) from two core samples taken at the connecting bar in Kushimoto, southern tip of Kii peninsula, Pacific coast of western Japan. We have taken five core samples at the elevation of 5.7 m a.s.l., in the high school ground located on the connecting bar (tombolo) in order to know the huge tsunami cycles which must have occurred along the Nankai trough subduction zone. We found a very clear tephra layer of Kikai-Akahoya(K-Ah) in one of the core samples, however no other tephra layers could be seen apparently. We divide core samples into every five centimeters and examine them with microscope. We can see many glass particles originated in volcanic ash through microscope in many core samples. Refractive index of every glass particles is measured to identify crypt tephra. Most tephras are identified to Kikai-Akahoya(K-Ah) or Aira-Tn(AT) reworked from surrounding slopes. Only two samples can be identified to Amagi-Kawagodaira tephra(Kg). We examined index of chemical components of volcanic glasses by EPMA. Consequently, we could discover Kg tephra not only at new locality, but also determine the period of a huge tsunami deposit occurred along the Nankai trough.

Keywords: Nankai Trough, crypt tephra, Amagi-Kawagodaira(Kg), tsunami deposit

Postglacial environmental change and prehistoric hunter-fisher-gatherer habitations in the Hokkaido region (northern Japan) inferred from pollen data and archaeological site distribution

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Substantial progress has been made on understanding the evolution of Late Pleistocene/Holocene hunter–fisher–gatherers. A growing body of evidence suggests that most of these groups did not, as was long assumed, remain relatively static and marginal over long periods. One area that has a rich, complex, and dynamic hunter–fisher–gatherer prehistory, which persisted until the middle of the 19th century AD, is the Hokkaido region. While empirical information about the hunter–fisher–gatherer archaeology in this region is increasing, understanding of the specific mechanisms driving the cultural trajectories remains insufficient. What specific mechanisms generated the observed hunter–fisher–gatherer cultural patterns and which role climate change played in these processes are two main research questions of the ongoing Baikal–Hokkaido Archaeology Project (BHAP, http://bhap.artsrn.ualberta.ca). Within this scope, we have (1) examined the spatio-temporal distribution of archaeological excavation sites in the Hokkaido region and (2) have evaluated the findings in view of key palaeoclimate records from the greater study area and the preliminary results of the palaeobotanical analysis of the RK12 sediment core from Lake Kushu (45° 25′58″N, 141°02′05″E; Rebun Island). The continuous and well-dated RK12 core covering the last ca. 17,000 years has been identified as a key palaeoenvironmental record for the region of northern Japan. The spatio-temporal analysis of archaeological sites in the Hokkaido region exhibits hunter–fisher–gatherer population dynamics from the Upper Palaeolithic (>14,000 cal yr BP) to the Ainu period (ca. 700–100 cal yr BP). Most cultural transitions coincide with periods of climate and environmental change. The data support the hypothesis that Palaeolithic subsistence was, at least partly, based on terrestrial hunting. The subsistence strategy shifted towards marine resources and plant exploitation alongside the early phases of the Jomon cultural complex paralleled by lateglacial climate warming, rising sea levels, and a change in regional marine currents. With continuous Holocene climate warming, site numbers increased suggesting a rise in population, which culminated in the Middle Jomon period (5000–4000 cal yr BP). At the same time, Jomon subsistence experienced a process of diversification and intensification in exploitation of natural food resources. These changes in the food economy probably allowed the persistence of the Middle Jomon culture beyond the Holocene temperature optimum (around 5000 cal yr BP). After, the population decreased until the end of the Jomon culture accompanied by a trend towards cooler climate conditions. During the Satsumon/Okhotsk culture periods (1500–700 cal yr BP) population re-increased. While the spread of Satsumon people into Hokkaido appears to have been controlled by human agency, immigration of Okhotsk people may be linked to climate cooling in the regions north of Hokkaido. Sites representing the following cultural period (Ainu, ca. 700–100 cal yr BP) re-decrease and show a concentration in eastern Hokkaido. It remains unclear what brought about the Satsumon–Ainu cultural transition. Thus far, there is no indication for any social or climatic factors having influenced this cultural transformation. Although most parts of the Hokkaido forager trajectory appear to be linked with environmental changes, causal relations need to be verified by future high-resolution and well-dated regional palaeoenvironmental records (e.g. the RK12

core) and dedicated archaeological research including conventional methods and more recent techniques like the "life history approach".

Keywords: Human–environment interactions, Hunter-fisher-gatherer cultures, Postglacial climate change, Neolithic, Palaeolithic, Hokkaido

Results of a preliminary study on the obsidian outcrops and Pre-Hispanic sites in Tenerife, Canary Islands

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The Canary Islands are an east trending volcanic archipelago located off the western Atlantic coast of North Africa. Tenerife Island, the largest in the seven island chain, was an active volcanic island formed in an active rift zone punctuated by repeated mountain formation and collapse. Volcanic activity on the island started 11.9 Ma, with 90% of the island’s volume created by 3.5 Ma during three distinct formation stages (Carracedo and Perez-Torrado, 2013). The latest formation created the Las Cañadas Caldera located in the middle of the island. This area includes the island’s tallest volcanoes Teide and Pico Viejo. Los Guanches were the indigenous population who inhabited the island from the late Holocene until Spanish colonization in the 15th century. This Pre-Hispanic society is characterized by life-ways focusing on hunting, gathering, and domestic plant use (e.g., barley). Although there is no evidence of metallurgy, technology focused on stone and osseous tools, ceramic pottery, and wood. Among tool resources, obsidian generated by the volcanic activities on Tenerife was a widely used raw material for making stone tools. The goal of this preliminary study is to collect basic data that helps evaluate Pre-Hispanic lifeways on Tenerife in terms of long-term use of island resources and to elucidate human-volcanic relationships on this geologically and biogeographically unique island. To do this, we focus specifically on the Pre-Hispanic exploitation of obsidian. Since the available data regarding obsidian use in Pre-Hispanic sites are limited, we conducted a field study focused on both (1) obsidian outcrops made by volcanic activities in the Las Cañadas Volcano, and (2) a systematic survey on the alluvial fans and gullies in the southern dry area of Tenerife. With permission from the Teide National Park, two known obsidian outcrops (Tabonal Negro and Tabonal los Guanches) in the central area of Las Cañadas Volcano (Hernández Gómez and Galván Santos, 2008) and a single outcrop along the northern coastal zone (Charco de Viento) were surveyed. Tabonal Negro is located on a phonolitic lava dome originated from Montaña Blanca and contains extensively distributed obsidian boulders dated to ca. 2000 BP (Ablay et al., 1995). The Pre-Hispanic artifacts samples (obsidian debitage and ceramic sherds) represent surface finds located on the alluvial fans deposited in between lava domes. These surface scatters are located in 2270 - 2300 m asl. Tabonal Guanches is an extensive lava flow located on the northern slope of Mt. Teide. Numerous obsidian workshops are identified in between the obsidian boulders that make up the Lavas Negras phonolitic lava flow. This flow dates to 1150 ±140 cal. BP based on charcoal samples obtained from just beneath the Lavas Negras. This suggests that the Guanches’ exploitation of Tabonal los Guanches was at least initiated after this period. The northern coastal region (Charco de Viento) where natural obsidian was outcropped is on the distal end of the lava dome (called as Abejara Alta) originated from the slope in 2500 m asl. The AMS radiocarbon date for the charcoal beneath the Abejara Alto is 5911 ±264 cal. BP (Carracedo et al., 2007, 2013), suggests that obsidian of Charco de Viento was generated no earlier than 6000 BP. During the survey campaign, no obsidian artifacts were identified on this part of the lava dome. In southern Tenerife, the archaeological survey took place in the Granadilla area among the extensive alluvial slopes at the outskirts of the Teide volcano. Because of the dry climate, alluvial slopes created numerous now-dry gullies, known as “barrancos”. Our three-day survey along the barrancos recorded a total of 32 scatters of artifacts attributable to Pre-Hispanic period. Among them, 29 scatters contained obsidian debitage. The surveyed region of Granadilla is covered with ignimbrite and

fallen pumice that included basalt flows. Obsidian was found from the alluvial terraces, although they are generally pebble size and poor in abundance. Conversely, the obsidian from the artifact scatters are larger in size and exhibit various appearances including translucent, opaque, and dark green, indicating that Guanches obtained obsidian from remote regions outside the Granadilla. As research continues, it will be critical to address three main questions: (1) Identifications of the distributions of natural obsidian outcrops, (2) Geochronology of obsidian-related lava flows and terraces/surfaces where archaeological sites are located, and (3) Geochemical sourcing of obsidian and other lithic materials using currently standardized methods. This research was supported by the JSPS KAKENHI Grant No 26350374.

Keywords: Tenerife Island, Obsidian, Lava flow, Pre-Hispanic, Resource exploitation

Subsurface geology beneath downtown Mashiki seriously damaged by the 2016 Kumamoto Earthquake

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Mashiki Town, Kumamoto Prefecture, SW Japan was seriously damaged by the 2016 Kumamoto Earthquake. Downtown Mashiki is located on the slope at the margin of an upland formed by the Aso-4 pyroclastic flow deposits. Particularly, building damage was concentrated at the lower part of the slope. The damage concentration was recognized from downtown Mashiki to Higashi-ku of Kumamoto City with a length of 3 km at least along the margin of the upland. We examined sediment cores and SPT samples drilled at three sites in the damage-concentrated zone and its surroundings (Yoshimi et al., 2016), and also carried out micro-tremor array surveys along sections across the zone.
Detailed examination of the sediment cores and the SPT samples reveals that subsurface geology (to the depth of 70 m) beneath downtown Mashiki is composed of a scoria and volcanic ash bed (Aso-3 pyroclastic flow deposits), a tuffaceous mud bed, a pumice and volcanic ash bed (Aso-4 pyroclastic flow deposits), a tuffaceous mud bed, a tephric loess bed, and an artificial fill in ascending order. Among them, the tuffaceous mud bed above the Aso-4 pyroclastic flow deposits exhibits a high water content and a very soft property. It was due probably to a generally shallow water table in the study area. Furthermore, the Aso-4 pyroclastic flow deposits are thicker beneath the lower slope than the upper slope.
Micro-tremor array surveys also reveal that a relatively soft layer with a S-wave velocity lower than approximately 300 m/s, which correspond to the pumice-dominated part of the Aso-4 pyroclastic flow deposits on the basis of the PS logging data (Yoshimi et al., 2016), becomes thicker beneath the lower slope and that the base of the layer decreases the elevation stepwise from the upper to lower slopes. Such distribution pattern of the strata is considered as one of the major factors involved in the maldistribution of the earthquake damage.
On the other hand, building damage was less conspicuous in the lowland south of the margin of the upland. The micro-tremor array surveys indicate that a soft layer with a lower S-wave velocity is distributed beneath the lowland. Further investigation is needed to understand the relation between the geologic properties and the earthquake damage in the lowland.

Reference: Yoshimi et al. (2016) Abstracts, 2016 Fall Meeting, JSAF, P-17.

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