

## Paleolithic human activity and summer temperature recorded in oxygen isotope of *Semisulcospira* from Sakitari-do archeolo

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Sakitari-do archeological site is located in Gyokusen-do cave system in Nanjo City, Okinawa Prefecture. Since 2009, this site has yielded important remains including a 12.4-ka-old human canine (Yamasaki et al., 2012). One of the noticeable animal remains is *Eriocheir* crub. Large and uniform size of the forceps indicates individuals of autumn season when this crub grows into an adult. Paleolithic people may have stayed in this cave during autumn and eaten *Eriocheir* crub.

In order to examine this hypothesis, this study focuses on *Semisulcospira* shell that was excavated together with *Eriocheir*. *Semisulcospira* is a freshwater gastropod that grows spiral shell. It is known that change in the water temperature was recorded in oxygen isotope of a series of samples collected along the spiral growth axis (Kano et al., 2008). If the Paleolithic people ate the gastropod, the oxygen isotopic value of the outermost sample indicates when it was taken. We analyzed the gastropod shell from two Paleolithic layers (19 ka and 12.4 ka) of the Sakitari-do site, as well as modern *Semisulcospira* collected a stream 5 km east from the site in late November 2013.

Paleolithic specimens from the Sakitari-do often exhibit a sign-shaped oxygen isotopic curve. Amplitude of the change is ~2 permil that corresponds to ~8 degree temperature change under stable water isotopic composition. More importantly, the outermost value locates on an autumn position in many specimens, which support the hypothesis based on *Eriocheir* remains. In contrast, the modern *Semisulcospira* specimens that lack the sign-shaped pattern were young individuals that born in early summer. They recorded temperature change from summer to November. Comparing the summer oxygen values, the modern specimens are 1-1.5 permil lower than the Paleolithic specimens. If the oxygen isotopic value has been constant, it can be evaluated that the Paleolithic summer water was 4-6 degree cooler than the modern summer water.

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Keywords: Paleolithic age, oxygen isotope, Okinawa

## Environmental changes of prehistoric culture of the Ryukyu, reconstructed by sedimentological studies of Haneji-naikai.

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The beginning of agriculture in Ryukyu Islands goes back to the 10th-12th century (Takamiya and Itoh, 2011). Land clearing for farm lands accelerated soil discharge into water systems in Ryukyu Islands due to heavy rain in summer. In a closed bay, finer-grained clastics can remain sub-merged for long periods, causing adverse effects in fishery.

In this study we will report on the analytical results for sediment cores recovered from Haneji-naikai. Haneji-naikai is a bay closed by the Yagachi and Okubu Islands. Its maximum water depth is 10 m with the area is 10km<sup>2</sup>. The Nasata river flows into the Haneji-naikai. In 2010 and 2012, 3-m and 24-m long sediment cores were recovered from the center of the bay. These were used to reconstruct the past environmental changes and human activities. The latter longer cores consisted of clay and silt with shell fragments from the surface up to the 16-m depth, while the lower part was composed of gravels. The radiocarbon dates of terrestrial plant fragments were 2880±40, 4210±30, 6150±40 and 31680±220 at the depths of 7.42 m, 10.78 m, 14.84 m and 23.90 m, respectively. The cores were subsampled at an interval of 2.3 cm to analyze carbon, nitrogen and sulfur (CNS) contents, magnetic susceptibility and visible color reflectance. It is considered that the Haneji-naikai was dried up around 30000 yr BP probably due to marine regression. The changes in TOC, TN and TS were recognized from 4m in depth, showing drastic decrease from 4m in depth. This suggests that the deforestation induced by agricultural activities have begun since 1000 yr BP in this region.

Keywords: Haneji-naikai, CNS analysis, Magnetic Susceptibility, Human activity, Ryukyu Islands

## Paleoenvironments analysis for the past 50 ka based on TOC and TN of the sediment cores INW2012-1 and -2, Lake Inawashiro

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The total organic carbon (TOC) and total nitrogen (TN) were measured at 2 cm interval for the long sediment cores (INW2012-1, INW2012-2) taken from a central site of 90 m depth in Lake Inawashiro in Fukushima Prefecture. Depth-age relationship has been established based on six <sup>14</sup>C data, and the bottom of the drilled core, about 28 m, is estimated as old as 48 ka. Sample interval is 50 to 100 years.

The compilation of information on lithology, TOC and TN concentrations, C/N ratio and water contents of INW2012-1 and -2 enable us to reveal the paleoenvironments of Lake Inawashiro from the early stage to the present with high temporal resolution. Deep condition of Lake Inawashiro started 42,000 years ago and then the lake has been constantly deep until now. Temporal change of TOC concentration of Lake Inawashiro shows the quasi-periodical fluctuation similar to the marine isotope curve known as LR04, and corresponds well to that of TOC concentration of Lake Nojiri in Nagano Prefecture. Vegetation change revealed at the Yanohara, moor in Fukushima Prefecture corresponds with the TOC fluctuation of TOC in the lake. Therefore, Temporal change of the TOC concentration in Lake Inawashiro seems to be controlled mainly by climate, probably temperature, and can be one of the useful paleoclimate records in the Tohoku region, Japan.

Keywords: Lake Inawashiro, TOC, TN, C/N, paleoenvironments, paleoclimate

## Environmental Changes based on the variations of the grain size distributions of MD179 cores, off Joetsu, Sea of Japan

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### 1.Introduction

Climate change during the Quaternary period experienced a 10,000year<sup>2</sup>glacial<sup>1</sup>interglacial cycle. This cycle has an influence on land formation. In Japan, the sea level changes, in coastal areas, and the variations of precipitations, at up stream and middle stream areas, change the riverbeds. Thus the marks from climate changes are expected to be archived around the rivers. However, the long term and continuous records hardly remain on the land, due to weathering and erosion. On the other hand, owing to the more stable environment, the continuous records are expected to remain on the seafloor(Tada et al., 1999). In this study, to reconstruct the correlation between the land formations and climate changes, the variations of the grain size distributions during past 130 ka on the East marginal area of Sea of Japan was revealed.

### 2.Study Area and Methods

There are a lot of Paleoenvironmental records concerning the Sea of Japan. In this study, 3 cores, which were sampled during the MD179 cruise in the Umitaka Spur and the Unnamed ridge off Joetsu, are used and the variations of grain size distributions of these cores were revealed. The Umitaka Spur is located in the continental slope. Moreover the sedimentation rate off Joetsu is very rapid (Nakamura et al., 2013; Ishihama, et al., in press) and the supply from the island arc is active (Freire et al., 2009). The supply from the Tateyama Mountains has the highest amount in Japan. So the of these supply are speculated to contribute to the sediment off Joetsu.

In this study the age models of these cores are constructed by using tephrochronology, radiocarbon dating, oxygen isotope ratio of foraminifer (Ishihama et al., in press) and additional data from tephra and radiocarbon dating. The organic matters in 485 samples from the 3 cores were removed by 10% $H_2O_2$ . Then the grain size distributions of these are analyzed by using SALD3000S (Laser diffraction particle size analyzer).

### 3.Result

The sediments off Joetsu are composed mainly of suspended load. The coarser sediments that contain little fine sand existed during the interglacial age. The variations of the median grain sizes off Joetsu have a similar pattern to the glacial cycles.

In general, it is assumed that the grain sizes of seafloor sediments become smaller as it gets farther from the land. Nevertheless, in this area, the variations in the size of the sediment supplied from land driven by the glacial cycles, have a large influence on the grain sizes of sediments in the study area, because of (1) the active supply from the rivers and (2) the narrow continental shelf.

However, in the case of the rapid rise in sea level, for example after LGM, the formation of alluviums in coastal zone is speculated to have an influence on the size of the sediment in study area.

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Keywords: Seafloor cores on MD179, Umitaka Spur, grain size analysis, Last Interglacial Age

## Developing process of the erosional landform and the developmental mechanism of slope failure in Shirasu area

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Pyroclastic flow deposits are distributed throughout Japan, dotting the country's landscape. In Kagoshima Prefecture, in particular, the cliff overlain by " Shirasu " deposits has undergone repeated slope failures during a period of several decades, which is an extremely short timeframe for such activity (Tsukamoto, 1993). Ito pyroclastic flow deposits are part of a huge pyroclastic flow that occurred approximately 29,000 years ago (Machida and Arai, 2003); these deposits span an area of approximately 90 km from Aira Caldera, which was the source of Shirasu deposits (Yokoyama, 2000). Although the stratigraphic relationship between the erosional landform and the Shirasu deposits of volcanic ash and gravel layers is important, little research has been conducted on this topic. Among the current and the former incised valleys engraving Shirasu plateau, an ancient fossil valley has been identified; however, the factors contributing to the ceasing of its growth remain unknown (Yokoyama, 2000). This study examined the relationship between the developmental mechanism of slope failure and the long-term development process of the erosional landform in the Shirasu distribution area to clarify the region's geomorphological evolution. In this presentation, we focus on the Satsuma Peninsula, which includes a part of the Shirasu plateau in northern area. In the peninsula, ancient shallowly incised valleys remain on the plateau, while the current deeply incised valleys have been dissecting the plateau. A landform classification map was made by interpretation of color aerial photograph in 1975 and by analysis of samples obtained from the plateau cliff that developed through erosion-denudation processes such as slope failure and erosion of Shirasu by running water; strength measurements were performed with a Schmidt hammer.

The valley width decreases rapidly from the main stream valley to the tributary valley and in the current incised valley, from downstream to upstream corresponding to the high-density distribution of failures in this site. The failure substance can be easily transported downstream because the " Shirasu " rapidly changes fine sand and silt after the failure. The failure at the valley wall slope has likely been continued by the valley width expansion of the current incised valley. Incision can be estimated from the beginning edge of the downstream side of the original Shirasu located in the place that is near to the East China Sea of the Satsuma Peninsula west, and has progressed in the upstream side gradually. This is probably because that the attitude of the Shirasu deposition surface is low, and the incised valley bottom is close to the base level of erosion, which has been almost stable during the last 7ka.

It is considered that lateral erosion of current incised valleys has continued during the time whereby failure has occurred in the vicinity of the lower end of the incised valley wall. From a long-term perspective, it can be said that the failure potential is high for current incised valleys dominated by width enlargement processes.

Keywords: Shirasu, Slope Failure, Records, Geomorphological Development, Southern Kyushu

## Total organic carbon fluctuation from the lake sediments in central Japan during the past 200 ka

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Lake sediment is a useful recorder of paleoclimate in the mid-latitude regions. However, the life span of a lake is shorter than that of the marine sediments or polar ice sheets in the most cases. Furthermore, a general condition of a lake may be disturbed by an accidental event. Then, we try to combine a climate proxy of total organic carbon (TOC) records from several lake sediments central Japan, and have compiled an average TOC in the past 200 ka which may correspond to the regional climate change.

Used data include Lake Biwa (BIW07-5, 6 core: 0-50 ka, BIW08-B core: 0-200 ka), Lake Nojiri (NJ88+NJ95 core: 0-72 ka), Takano Formation (TKN-2004: 38-160 ka). The time resolutions in those data are between 20-100 years. TOC data of the six sediment cores were normalized as dividing a data by standard deviation. Their fluctuation curves of the normalized TOC were matched by the method of Lisiecki and Lisiecki (2002). Then the matched normalized data were interpolated at 100-year interval by polynomial interpolation method.

The compiled TOC fluctuation in central Japan is well correspond to the D18O curves of the marine sediments (LR04) and the Greenland ice core (NGRIP) respectively both in the orbital and millennial time scales. In late MIS (marine isotope stage) 7 and MIS 1, the compiled TOC values are generally high. In MIS 6, 4 and 2, the TOC values are generally low, and their temporal fluctuation is not so large. The compiled TOC in MIS 5 is characterized by large fluctuation in orbital scale. In contrast, the compiled TOC in MIS 3 shows many peaks which correspond with the repetition of cold stadials and warm interstadials, known as D-O cycle.

This result suggests that the normalized TOC may be a useful proxy of paleoclimate for the past 200 ka, which can be correlated with other sediments or climate records by the many marker tephra beds in central Japan.

Keywords: Total organic carbon, past 200 ka, central Japan

## Morphosis of the Oyster shell bed and Diatom assemblage in Tokyo bay

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Recently, oyster shell beds and reefs have been found in various places in Tokyo bay. Six shell bed types can be recognized on the basis of their lithology (YOKOYAMA et.al., 2004). Topographic and paleogeographic changes closely related to the Holocene Jomon Transgression, have been investigated by reconstructing the migration of oyster shell beds, which are good markers of paleoshorelines, throughout the wide inner bay during the rising stage of sea-level. However, ecology of benthos and diatom assemblages is not clear about oyster shell bed types(Endo et.al.,2013 ). This study describes taphonomic processes of the oyster reefs well exposed in Tokyo bay, Sanbanze. The oyster reefs of Sanbanze have grown up during about 5 years. The growth of oyster reefs was rapid but nowadays it is reduced due to change of oyster environment as consequences of Torrential rain and Typhoon. We started to do research 5 years ago in Sanbanze. We are making a report on oyster shell bed types and ecology of diatom assemblage in this area.

Keywords: Tokyo bay, oyster shell bed, diatom

## A possibility of influence of deposition in dam-lake to deep marine environments around the Japanese Islands

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It is well known that dams construction on river caused decrease in sediment supply and serious coastal erosion. While, taking into account similarity of grain size, deposition in dam-lake may also cause decrease in deep marine hemi-pelagic depositional rate. Mass accumulation rate (MAR) during ca. 100 years around the Japanese Islands were estimated with Pb-210 radioactivity concentration.

Core samples were obtained with multiple corer (core length <60 cm) on the R/V Tansei-maru from off the Enshu, Kumano and Niigata regions in the central Japan. Subsamples sliced with 1 or 2 cm thick were dried, crushed and measured by an ORTEC High Purity Ge gamma spectrometer housed in the Department of Geography, Tokyo Metropolitan University with a 48 hour counting. MAR was estimated from Pb-210 radioactivity concentration and dry bulk density of other subsamples measured with the Shimadzu Accupyc 130 gas pycnometer housed in Atmosphere and Ocean Research Institute, the University of Tokyo.

In the off Enshu area, MAR of two core samples obtained from small basin on the outer ridge-Nankai Trough slope (ca. 2500 m water depth) were estimated for this study. Although one core did not show change in MAR, the other core showed decrease in MAR around 1930-1940. In the off Kumano area, MAR of two core samples obtained from bottom of the Kumano Trough (ca. 2100 m water depth) were estimated. Both core showed decrease in MAR around 1940-1960. In the off Niigata area, MAR of a core sample obtained from bottom of submarine canyon on the SE slope to the Mogami Trough (ca. 400 m water depth) was estimated. The core showed decrease in MAR around 1960-1970.

Although estimated ages of decrease in MAR have considerable error, it is remarkable that decrease in MAR was estimated from all the studied areas. Contemporaneity of decrease in MAR and dams construction and similarity of the grain size between hemipelagic sediment and dam sediment suggest that deposition in dam-lake may influence sediment supply to deep marine hemipelagic environment.

Keywords: dam, hemipelagi deposits, mass accumulation rate