Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS25-P01 Room:Convention Hall Time:May 24 16:15-17:30

Characteristic of surface sediment left by 2011 Tohoku earthquake, case study of Hirota bay

Yuka Yokoyama[1*], Izumi Sakamoto[1], Yoshiyuki Takino[1], Yasuhiro Takashimizu[2], Masatoshi Yagi[1], Ayaka Suzuki[1], Aya Endo[1], Riichiro Imura[1], Kenji Nemoto[1], Takeshi Kito[3], Yasuo Matsui[3], Shuro Yoshikawa[4], Takafumi Kasaya[4], Yoshihiro Fujiwara[4]

[1]Tokai University, [2]Niigata University, [3]FODECO, [4]JAMSTEC

The recent 2011 Tohoku tsunami strongly affected the coastal area of the Pacific coast of Tohoku. The result of onshore features for tsunami impact is well-reported, but offshore is only a few researches.

In this presentation, we will show about distribution of tsunami deposit left by 2011 Tohoku earthquake at Hirota bay. We researched about tsunami origin sediment using acoustic equipments (Multi beam echo sounder, Sub bottom profiler and Side scan sonar), bottom sampler and ROV.

Hirota bay have a few fairways at coast side that from between submerged breakwater to valley by submarine topography data. East side of this bay (around Kesen-river) have strong reflected intensity depending on SSS image, and lead up to offshore (depth approximately17m) from river side. Distribution of surface sediment is mainly sand, gravel where locally-distributed near the river side by grain size analysis, and a few sediments with woodchip, shell piece etc.

SBP data confirmed surface sediment characterized by inside reflecting at the valley axis of bay, and clearly different from lower sediment layer.

Sand to silt sediments layer with grading (fine to medium) structure observed at the top of the columnar core (0-40 cm) sample. The lower part of this layer consists gravel and shell fragments, and has contact the unconformable relations with the lower sediment layer. Underlying layer is massive sediment with fine sand to clay (40-70 cm) materials. We assume that denudation is boundary of previous or after tsunami sediment and upper layer is tsunami origin sediment. This boundary has continuity reflecting surface by SBP data and confirm distribution of this reflecting surface and thickness. We were able to estimate tsunami origin sediment distributed with thickness approximately 20-50cm, and high thickness was distributed to the fairway.

Keywords: Tsunami origin sediment, Sanriku coast

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MIS25-P02 Room:Convention Hall Time:May 24 16:15-17:30

Characteristic of submarine topography and sediment left by 2011 Tohoku earthquake, case study of Okirai and Toni bay

Yuka Yokoyama[1*], Izumi Sakamoto[1], Yoshiyuki Takino[1], Yasuhiro Takashimizu[2], Masatoshi Yagi[1], Daisuke Kanai[1], Riichiro Imura[1], Kenji Nemoto[1], Takeshi Kito[3], Yasuo Matsui[3], Shuro Yoshikawa[4], Takafumi Kasaya[4], Yoshihiro Fujiwara[4]

[1]Tokai University, [2]Niigata University, [3]FODECO, [4]JAMSTEC

The recent 2011 Tohoku tsunami strongly affected the coastal area of the Pacific coast of Tohoku. The result of onshore features for tsunami impact is well researched, but offshore is only a few researches.

In this presentation, we will show about characteristic of submarine topography and tsunami origin sediment left by 2011 Tohoku earthquake at Okirai and Toni bay. We researched about tsunami origin sediment using acoustic equipments (Multi beam echo sounder, Sub bottom profiler and Side scan sonar), bottom sampler and ROV.

We got the submarine topography data at Okirai (water depth: 2-105 m) and Toni bay (2-112 m). Both bay have valley in valley (Okirai 75 to 90 m and Toni 70 to 90 m) and scattered irregularity bottom surface (Okirai 15-20 m and Toni 17-25 m). This irregularity bottom surface height is about 20-100 cm at Okirai. In SBP survey, this signature topography has a feature of non-bedding with strong reflector surface.

Characteristic of columnar core have thin lamina layer (0-16 cm) with woodchip, grading structure (fine to coarse) of sand sediment with shell piece (16-65 cm) have observed. Underlying layer of sand sediment is reddish brown clay and it has erosion structure between sand sediment (16-65 cm) and this layer. It was guessed that erosion structure was made by turbidity current by tsunami activity. This erosion boundary has continuous reflecting surface by SBP data, and confirm distribution of this reflecting surface and thickness. We were able to estimate the reflecting surface to depth of approximately 40 m. And, it was estimated that tsunami origin sediment was distributed with thickness around 20-100cm.

Keywords: Tsunami origin sediment, Sanriku coast

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MIS25-P03 Room:Convention Hall Time:May 24 16:15-17:30

Characteristics of tsunami origin sediments sampled from Hirota and Toni bay around the Sanriku cast, Japan.

Izumi Sakamoto[1*], Yuka Yokoyama[1], YoshiyukiTakino[1], Yagi Masatosi[1], Riichiro Imura[1], Satsuki Iijima[1], kenji Nemoto[1], Yasuo Matsui[2], Takeshi Kito[2], Yasuhiro Takashimizu[3], Syuro Yoshikawa[4], Yoshihiro Fujiwara[4], Takashi Kasaya[4]

[1]Tokai University, [2]FODECO, [3]Niigata Univ., [4]JAMSTEC

The recent 2011 Tohoku tsunami strongly affected the coastal area of the Pacific coast of Tohoku. Tokai University with JAMSTEC investigated the Tohoku coastal area as a part of Tohoku Ecosystem-Associated Marine Sciences (TEAMS). We got the columnar core samples for give an account of bottom sediment environment and got the character of tsunami origin sediment.

Hirota bay is typical rias coast characterized by narrowing of bay size from bay entrance (6 km) to closed-off section of bay (3 km) and axial angle is northwest to southeast. Toni bay size is comparatively small (east to west angle 6 km and bay entrance 4 km).

The high-resolution sub-bottom profiling shows wide variety of sedimentary facies layer by each bay. These layers are distinguished clearly from basement (underlying) layers.

We got the columnar core using vibration bottom sampler at Hirota (6 station, max length approximately 2 m) and Toni bay (6 station, max length approximately 1 m).

By the result of Hirota columnar core sample, it was seen grading (fine to medium) sand sediment contain the woodchip and shell piece at the surface zone (0-10 cm). Underlying layer (10-50 cm) was seen coarse to medium grained sediment with woodchip and shell piece, and lower part of this layer eroded out the underlying silt layer. We supposed the surface-grading layer with medium to fine sand (0-50 cm) was tsunami origin sediment. The longest (2 m) core was seen coarse to gravel sediment contain woodchip and shell piece (0-20 cm), and it was scraping underlying massive silt to fine sand layer. From 130 cm underlying layer was seen middle to coarse sand sediment again. So, we think that underlying layer sediment (from 130 cm underlying layer) of 2m core has possibility of past tsunami origin sediment.

Characteristic of columnar core at Toni have lamina with woodchip (0-16 cm), grading (fine to coarse) sand sediment with shell piece (16-65 cm). Sand sediment of underlying layer is reddish brown clay, and has erosion between sand sediment (16-65 cm) and this layer.

We were able to estimate that the surface layer with grading structure (fine sand at the surface and coarse sand with gravel from lower part) of columnar core was the sediment gravity flow caused by the tsunami activity.

Keywords: Sanriku Coast, tsunami origin sediment

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Numerical investigation of the relationship between tsunami hydrodynamic features and the distribution of the deposits

Kohei Hashimoto[1*], GOTO, Kazuhisa[2], SUGAWARA, Daisuke[2], IMAMURA, Fumihiko[2]

[1]Tohoku University School of Engineering, [2]Tohoku University International Research Institute of Disaster Science (IRIDeS)

Considering about the magnitude, inundation and damaged area of the paleo-tsunamis is important for evaluating the risks of the low-frequency large-scale earthquakes and tsunamis that might occur in the future (Imamura and Goto , 2007). Sandy tsunami deposits extended to inland is used as evidence of minimum inundation limit of the paleo-tsunami (e.g. Sugawara et al., 2010; Satake et al., 2008) to estimate the earthquake magnitude and focal mechanism of the paleo-tsunami wave source. However, the source model of the 2011 Tohoku-oki tsunami showed unusual fault parameters (i.e. 50 m slip around the trench axis (Geospatial Information Authority of Japan, 2011)) in comparison with the AD869 Jogan tsunami source model. This suggests that if we use the landward extent of the sandy deposits as the minimum extent of the inundation distance of the 2011 Tohoku-oki tsunami, the results may underestimate the actual (observed) inundation distance (Hashimoto et al., 2013). Reconsidering the estimation accuracy such as the tsunami wave source model using tsunami deposits distribution is critically important for future tsunami risk evaluation.

Takashimizu et al. (2012) said that it is important to confirm the relationship between tsunami flow depth and the thickness of the tsunami deposits, so that they investigated the 2011 Tohoku-oki tsunami deposits distribution and flow depth to study relationship of them. Hashimoto et al. (2013) studied the relationship between the distribution of the tsunami deposits, and calculated tsunami hydrodynamic features (maximum flow depth and velocity). However, maximum flow depth and velocity are not necessarily the sole parameters to explain the sedimentation process of the tsunami deposits.

In this study, we reconsider the relationship between the distribution of the tsunami deposits at Sendai Plain and hydrodynamic features such as flux, integral value of the velocity or Froude number.

Keywords: Tohoku-oki tsunami, Tsunami deposit, Sendai Plain, Numerical simulation

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MIS25-P05 Room:Convention Hall Time:May 24 16:15-17:30

Numerical simulation of tsunami deposition by the 2011 Tohoku-oki earthquake in Sendai Plain

Daisuke Sugawara[1*], Tomoyuki Takahashi[2], IMAMURA, Fumihiko[1]

[1]Tohoku University, [2]Kansai University

Geological research on paleotsunami events is essential for reliable evaluation of risks from infrequent large-scale earthquake. Numerical simulation of tsunami sediment transport will give aid for quantification of the inundation area, hydraulic character and wave source of the past tsunamis. A lot of numerical studies have been carried out during the last decades, taking modern examples into account, such as the 2004 Indian Ocean tsunami. The 2011 off the Pacific coast of Tohoku (Tohoku-oki) earthquake may offer a valuable opportunity to enhance the utility of tsunami deposits and its numerical simulations, on the basis of abundant datasets such as densely-measured tsunami trace heights, high-resolution digital elevation model (DEM) and tsunami records from tide observations.

Numbers of previous studies have reported sedimentological feature of the 2011 Tohoku-oki tsunami deposits in the Sendai Plain (e.g. [1]). The tsunami deposited sandy to muddy sediments up to 30 cm in thickness, and distributed them up to several kilometers inland. It is notable that the maximum inland extent of the sandy tsunami deposit reached only 60-70% of the inundation distance, and the thickness of the sand layer showed significant variations across shore-normal transects [1][2]. Quite minor contribution from sea-bottom sediments to the onshore tsunami deposit have been confirmed through the grain-size, microfossil and geochemical analyses [3][4], implying that most of the onshore tsunami deposits are originated from the shallow sea closed to the coast, beach and inland areas. It is highly likely that the flow condition and also sediment transport would have been affected by natural and anthropogenic topography, such as dikes installed on the top of sand dunes, roadways on elevated mounds. Numerical simulation of the tsunami sediment transport in the Sendai Plain should incorporate the effects from such kinds of topographic features.

A numerical analysis on sedimentation by the Tohoku-oki tsunami is performed in the present study. The tsunami source is based on the fault model proposed by Sugino et al. [5], which reasonably reproduce the terrestrial geodetic data and tsunami records from offshore and nearshore tide stations. The tsunami propagation is calculated using a numerical code based on the shallow-water theory (TUNAMI-N2; [6]), and the tsunami sediment transport model by Takahashi et al. [7] is coupled with it. A high-resolution DEM (dx = 5 m) and land use map with same resolution are used to incorporate the effects from complex topographic features and land covers.

The preliminary result showed that entrainment of sediments from the beach and massive erosion around the engineering structures mainly accounts for the origin of sand layer deposited inland. Shore-normal distributions of the calculated thickness of sediments reasonably agree with the distribution trend and local variation of the tsunami deposits observed in the field. There are many issues to be resolved for direct comparison of numerical result and field data. In this presentation, applicability and limitation of the current tsunami sediment transport model is examined, and desirable strategy for data correction in the field will be discussed.

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Keywords: tsunami deposit, numerical simulation, sediment transport, The 2011 Tohoku-oki earthquake tsunami

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Thickness and grain size fluctuation of the 2011 Tohoku-oki tsunami deposit in Sendai and Joban coasts, Japan

Tomoya Abe[1*], Kazuhisa Goto[2], Daisuke Sugawara[2]

[1]Department of Geography, Nagoya University, [2]International Research Institute of Disaster Science, Tohoku University

In general, tsunami deposits thin and fine landward, although local microscopic topographic features give strong effects to the distribution trend of the deposits. For instance, post-tsunami field surveys after the 2011 Tohoku-oki event revealed that the thickness and grain-size varies significantly because of the small-scale undulations (Nakamura et al. 2012), redistribution of the vented sediments from liquefaction (Goto et al. 2012) and scouring at the lee side of engineering structures (Takashimizu et al. 2012). Investigation of local variability of thickness and grain-size of modern tsunami deposits are a key to better understand of the formation process of the tsunami deposits. However, it is usually difficult to consider such local effects in case of paleotsunami events. Therefore, it is rather important to clarify the characteristics of general thickness and grain-size trends and the physical formation process of tsunami deposits from modern examples. Such findings can be applied for estimating the size and hydraulic behavior of paleo-tsunamis.

In this study, the 2011 Tohoku-oki tsunami deposits were investigated along twelve shore-normal transects on the coastal lowland in Miyagi and Fukushima prefectures, northeast Japan. Inundation distances at each transect ranged from 0.6 to 4.1 km. Trench surveys of the tsunami deposits were conducted at over 500 sites from April 2011 to November 2012. Deposit thickness, grain-size and sedimentary structures were documented and samples were retrieved from each site. Grain size of the tsunami deposit was measured using settling tubes.

Total thickness of sand and mud, and thickness of sand layer generally showed a landward thinning trend in each transect. Between 1.5 and 2 km inland from the shoreline, the total thickness was less than 10-15 cm, and father inland (over 2-2.5 km) it was thinned below 5 cm. The sand layer was less than 10-15 cm in thickness between 1.5 and 2 km inland, less than 5 cm from 2 to 3 km inland, and $<$0.5 cm at further inland (more than 2.5-3 km from the coastline). The thickness of mud layer was less than 5 cm at each location and there was no obvious landward trend. Mean grain size showed a landward fining feature up to 2 km inland, but it showed a fluctuation ranging from 1.5 to 2 phi. Meanwhile, the grain size rapidly fined landward down to 3 phi at 2-2.8 km from the shoreline.

We found a general landward thinning trend of the total thickness of the tsunami deposits. However, the thickness was largely varied in a zone up to 1.0-1.5 km inland. In this area, the thickness was likely to be sensitive to the local undulation of topography. According to the grain size analysis, bed-load transport might have been dominated in this section. Along short transects ($<$ 2 km), there was no remarkable difference in the thickness of sand layer near the coastline and at the inundation limit. Hence, it is likely that the sediment-transport capacity of the tsunami was well maintained at least 2 km inland. Besides, absence of the thick tsunami deposits ($>$0.5 cm) between 2 and 3 km inland may explained by the following reasons: (1) limited sand supply from the source (i.e. sand dunes developed within 0.5-1 km from the coastal line; Szczucinski et al. 2012), (2) decreasing in sediment transport capacity because of reductions of the flow speed and depth during tsunami inundation.

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Keywords: 2011 Tohoku-oki tsunami, tsunami deposit, thickness, grain size

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Effect of topographical and hydraulic features on distribution range of the 2011 Tohoku-oki earthquake tsunami deposit

Takumi Yoshii[1*], Takaomi Hamada[1], Toshinori Sasaki[1], Masafumi Matsuyama[1], Koichi Okuzawa[2], Masakazu Watanabe[2]

[1]Central Research Institute of Electric Power Industry, [2]Civil Engineering Research and Environmental Studies

Effect of topographical and hydraulic features on distribution range of tsunami deposit was investigated after the 2011 Tohoku-oki earthquake tsunami. We visited coasts located from Misawa city in Aomori Prefecture to Sammu city in Chiba Prefecture and investigated 19 coasts which had been clearly inundated by the tsunami. We confirmed tsunami deposit in 18 coasts with a slope of less than 0.08 and tsunami deposit reached near the limit of the tsunami inundated area in 15 coasts though the run-up height of the tsunami is less than 10 m in some coasts. The detail analysis of the obtained sample and estimation of hydraulic features of the tsunami inundation using a numerical simulation are still ongoing. We are going to show more data in the presentation.

Keywords: tsunami deposit, the 2011 Tohoku-oki earthquake, field investigation, numerical simulation

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Taphonomical process of sandy tsunami deposit based on field observations at 1 year after the 2011 Tohoku-oki tsunami

Yugo Nakamura[1*], Yuichi Nishimura[1]

[1]ISV, Hokkaido University

Deposited tsunami sediment immediately begins to experience the effects of physical, chemical weathering, and bioturbation, and is altered into the *fossil* tsunami deposit. This study discusses alteration and preservation process (i.e. taphonomy) of tsunami deposit on the basis of field observation of facies, thickness, distribution, and covering layer of the 2011 Tohoku-oki tsunami deposit one year after the tsunami event. The 2011 Tohoku-oki tsunami caused severe damage to the coastal regions of eastern Japan and left a sediment veneer over affected areas. The tsunami deposit thickness tapers landward from 56 cm to few millimeters across a gentle slope lowland. At 1 year after the event, thin tsunami deposit around the run-up limit is hardly distinguishable because it has been eroded or mixed with humic soil. On the other hand, the relatively thick deposit, more than 2 cm in general, has preserved original depositional structures and thickness. In the forest, the tsunami deposit has been covered with organic debris or partially decomposed organic debris layer. The tsunami deposit beneath the covering layer seems to be well preserved. Because the thin tsunami deposit has been lost in one year after the event, the area where the 2011 deposit can be observed has become smaller than the tsunami inundation area. Therefore, inundation area and flow height which have been estimated from distribution of paleo-tsunami deposit is tend to be underestimate. Knowledge on the alteration process on tsunami deposits, tsunami-taphonomy, increases the potential precision for paleo-tsunami researches.

Keywords: Tsunami deposit, Taphonomical process, Weathering, 2011 Tohoku-oki tsunami

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Distribution and origin of the 17th century tsunami deposit in the Iburi coast, Shiraoi district, central Hokkaido

Ryo Nakanishi[1*], Okamura Satoshi[1], Takashimizu Yasuhiro[2], Sagayama Tsumoru[3], Nishina Kenji[3]

[1]Hokkaido University of Education, [2]Niigata University, [3]Geological Survey of Hokkaido

Pacific coast in Hokkaido is frequently suffered tsunami disaster caused by earthquakes associated with the Kuril Trench subduction. The 17th century tsunami deposits are discovered in eastern Hokkaido (Nemuro-Kushiro), central Hokkaido (Iburi coast) and western Hokkaido (Uchiura bay). But the tsunami deposits in the Iburi coast have unconfirmed trigger of tsunami yet. Conceivable candidates of its trigger are 1640 Hokkaido Komagatake eruption, 1611 Keicho-Sanriku earthquake and earthquake along the Kuril subduction zone occurring 300-500 years interval. We surveyed Shiraoi district in the Iburi coast, blank area of research, and studied distribution and origin of the tsunami deposits. We draw 4 survey lines perpendicular to shoreline, and investigated by a handy boring method.

Shiraoi district reaches back marsh behind sand dune, and is characterized by flat to gentle slope topography toward shore. Shikotsu pyroclastic flow deposits distribute inland. The Stratigraphic units of the Shiraoi district are divided into Us-b (1663) tephra, tsunami deposits (with thin peat at most upper part), peat, B-Tm tephra (20cm lower part from tsunami deposits), in descending order. The tsunami deposits are distributed with 14km length along the Iburi coastline and 0.6-0.9km width to landward. The deposits rapidly decrease in thickness at half inland of the deposition, and indicate a thin sheet-like distribution to the landward. The finer grain size distribution and increasing pumice grain to landward. Diatom fossils in the tsunami deposits include marine species of 18%. Constituting particles are similar grain sizes and assemblages to beach sand and dune sand. These results suggest that the deposits are transported from seaside, and correlate to the 17th century tsunami deposits distributed widely along the Iburi coast, Tomakomai and Mukawa.

Vertical sedimentary structure of the deposits near the coastline indicates inverse grading (lower unit), normal grading (middle unit) and normal grading (upper unit), in ascending order, which suggests at last two tsunami inundation events. Grain-fabric analysis of the each unit indicates that these deposits were formed by inflows with NNW paleo-flow directions. Distribution scales, a distance from the seacoast and a highest altitude of the deposit, in comparison with other 17th tsunami deposits from the Iburi coast, are more larger at eastern Mukawa area than western Siraoi and Yufutsu areas, which suggests the deposits are attributed to the eastern Kuril Trench origin earthquake.

Keywords: Tsunami deposit, Hokkaido, 17th century, Grain size analysis, Grain-fabric

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Tsunami deposits survey around Japan Sea coastal area, Hokkaido

Wataru Hirose[1*], Gentaro Kawakami[1], Jun Tajika[1], Satoshi Ishimaru[1], Hiroshi Fukami[1], Tatsuya Watanabe[1], Ryo Takahashi[1], Kenji Nishina[1], Tsumoru Sagayama[1], Kenichi Koshimizu[1]

[1]Geological Survey of Hokkaido

At the eastern margin of Japan Sea, many large-scale earthquakes, such as ”The 1993 off the southwest coast of Hokkaido Earthquake” have occurred, and accompanied ”Tsunami”, that damaged around the Japan Sea shoreline of Hokkaido. However, because of the absence of reliable historical records in Hokkaido, high-density geological survey would be needed, especially the recognization of ”Tsunami deposits”.

Historical disaster This Tsunami deposits survey have conducted by our group and Hokkaido local government. We survey around whole shorelines from Wakkanai to Matsumae, and especially Okushiri Island. In the Okushiri island, we recognize several event deposits accompanied Tsunami. Event deposits, such as sand bed with gravel are intercalated in peat or silt. The ages estimated stratigraphic and radiocarbon age are 1741 (accompanied with the Oshima-oshima volcano eruption), 11-13 centuries, 6-7 centuries, 2.3ka, 2.6-2.7ka, 3.1-3.3ka respectively.

At the Japan Sea shoreline area of Hokkaido, sand and gravel beds could recognized at 7 sites in 2011 survey, 26 sites in 2012 survey, respectively. mainly southern area and northernmost area. Geological, geographical and geochemical detailed work would be needed.

Keywords: Hokkaido, Tsunami, Earthquake, Debris avalanche, Geological Hazard

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Tsunami Deposits Survey in the Bishamon Bay at the Southern Tip of the Miura Peninsula, Central Japan

Haeng Yoong Kim[1*], MANNEN, Kazutaka[1], SASAGE, Kazuo[2]

[1]Hot Springs Research Institute of Kanagwa Prefecture, [2]PASCO Co.

Tsunami Deposits Survey in the Bishamon Bay at the Southern Tip of the Miura Peninsula, Central Japan

Keywords: Tsunami Deposits, Kanto Earthquake, Miura Peninsula, Bishamon Bay

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Detection of tsunami deposits: utilizing benthic foraminifera of the former Hojozu Lagoon, Imizu City, Toyama Prefecture

Saori Yano[1*], Akira Takeuchi[1]

[1]Toyama Univ.

This research aimed at discovering any marine event-sediments, such as tsunami deposits and storm-sediments, by utilizing the ore samples of drillings performed in Hojozu Lagoon by means of benthic foraminifers.

Using box-cored sediments recovered from the bottoms offing the river mouth of Kurobe River, the present distribution of benthic foraminifers in the Toyama Bay was examined under a stereomicroscope, with the reference of the depth distribution of benthic foraminifers and contrast with correspondence water reported by the previous research.

In order to extract benthic foraminifers, the core samples of Hojozu Lagoon were also examined under a stereomicroscope, and a marine event-sediment was detected in comparison with the water mass corresponding to depth distribution of a marker foraminifera.

As the result, it became clear that benthic foraminifers of Toyama Bay including Ammonia ketienziensis are as available for a marker species judging for a tsunami deposit.

From the core samples of Hojozu Lagoon, before the end of the Yayoi Period (ca. 1,900 yr B.P.) after the Middle Jomon Period (ca. 5,000 yr B.P.) in age, a probable marine event -sediment of either tsunami or storm and also a possible tsunami deposit were discovered.

The characteristic feature of the former marine sediment is coarse-grain sand included, and that of the tsunami deposit is content of many pieces of sea shells and from medium-to coarse-grained sands. Roundness and degree of sorting of both those sediment particles are low. Moreover, as for the source of supply of sediments, it is presumed that the former is not deeper than the middle sublittoral zone, and that the later is not deeper than the outer sublittoral zone.

The foraminifer method used in this study is expected to be a promising tool for discrimination of tsunami deposits from storm-sediments from marine-event sediments.

Keywords: tsunami deposits, storm deposits, hojozu lagoon, holocene

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Preliminary results of a paleotsunami study by hand coring in coastal lowlands, eastern Kyushu

Masaki Yamada[1*], Shigehiro Fujino[2], Takashi Chiba[2], Kazuhisa Goto[3], James Goff[4]

[1]Graduate School of Life and Environmental Sciences, University of Tsukuba, [2]Faculty of Life and Environmental Sciences, University of Tsukuba, [3]International Research Institute of Disaster Science, Tohoku University, [4]Tsunami and Natural Hazards Research Group, University of New South Wales

The AD1662 Kanbun Hyuga-nada, AD1707 Hoei, AD1769 Meiwa Hyuga-nada and AD1854 Ansei Nankai tsunamis that occurred along Nankai Trough and Hyuga-nada all struck the east coast of Kyushu (Hatori, 1985). In particular, the AD1662 Kanbun Hyuga-nada tsunami inundated the extensive Miyazaki Plain, and based on the historical documents Hatori (1985) estimated that the inundation height was 4-5 m. The fault rupture area of the AD1707 Hoei earthquake is thought to have extended to the west of the Cape Ashizuri (Furumura et al., 2011) with the resultant tsunami being about 3-4.5 m high at the northeast coast of Kyushu, although it was thought to have been comparatively small in the southeast (Hatori, 1985). However, if the rupture area of an earthquake was to extend further west, a higher tsunami could strike the southeastern coast of Kyushu.

Paleotsunami deposits in stratum provide helpful information for disaster risk reduction such as the inundation area and recurrence intervals of paleotsunamis that have no historical records. However, studies of paleotsunami deposits do not cover all of the Pacific coastal lowlands of Japan at the current moment. In eastern Kyushu, sandy paleotsunami deposits were reported from Ryujin Lake in Oita Prefecture (e.g., Matsuoka and Okamura, 2008), but there has been no detailed study of paleotsunami deposits in the south of the Miyazaki Prefecture. The purpose of this study is to reveal the tsunami history over thousands of years in eastern Kyushu by using paleotsunami deposits.

We started a preliminary research of paleotsunami deposits by hand coring coastal lowlands in Kagoshima, Miyazaki and Oita prefectures in March 2012. In this presentation, we mainly discuss geological data obtained from coring at Kushima lowland, Miyazaki Prefecture. This 550 m wide drowned valley lowland faces Shibushi Bay and is surrounded by 10-30 m high hills. We conducted core logging at 19 study points along 300 and 450 m shore-perpendicular transects and collected samples for radiocarbon dating and diatom analysis.

The 4-6 m sedimentary successions of these study sites are composed from bottom to top of fine to medium dark-gray sand with granular, green-brown organic-rich silt, black-brown organic-rich peaty silt, blue-gray clay and agricultural soil. Several sand layers was found in the organic-rich peaty silt and blue-gray clay at many study points. Marine and brackish diatoms were found from sand layers at around the boundary between the lower green-brown organic-rich silt and the upper organic-rich peaty silt. This indicates a possibility that these sand layers were transported inland from sea area by a high energy flow. Although they could have been deposited by paleotsunamis, more criteria such as lateral consistency in the sedimentary succession are needed for identification of these layers as paleotsunami deposits. Using diatom analysis, we will also examine the environmental changes that might have occurred simultaneously with deposition of the sand layers.

Keywords: tsunami deposit, Kyushu, Miyazaki Prefecture, Nankai Trough, Nankai earthquake, Hyuga-nada earthquake

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS25-P14 Room:Convention Hall Time:May 24 16:15-17:30

A Study of Paleo-Tsunami along the Coastal Area of Miyazaki Prefecture, south-western Japan

Takanobu Kamataki[1*], Masakazu Niwa[2], TAKATORI, Ryoichi[2], Masafumi Ikuta[2], Hideki Kurosawa[3]

[1]Akita University, [2]Japan Atomic Energy Agency, [3]OYO Corporation

Tsunami is the most destructive natural disaster on the coastal area. Eastern Kyushu along the Pacific coast has been suffered by tsunamis, such as the 1662, 1769, and 1984 tsunamis. Recently, tsunami deposits have been reported from various areas and environments in Japan. However, paleo-seismological study based on the tsunami deposits has not been reported from along the Hyuganada. We report a study of paleo-tsunami along the coastal area of Miyazaki Prefecture. These results will be presented in this session.

Keywords: Miyazaki prefecture, tsunami deposit

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Subaqueous Tsunami Deposites from southern part of Okinawa Island of Naha city

Chiaki Gushikawa[1*], Tsuyoshi Haraguchi[2], Mamoru Nakamura[1], Yasuhisa Arashiro[3], Shota Shiga[1]

[1]Faculty of Science, University of the Ryukyus, [2]Department of Geosciences,Graduate School of Science,Osaka City University, [3]Graduate School of Science and Technology, University of the Ryukyus

Since the interplate coupling is assumed to be weak along the Ryukyu Trench, the occurrence of large interplate earthquakes is assumed to be unlikely. However, locally coupled area is observed near Okinawa Island in the central Ryukyu Trench (Nakamura et al., 2010). Furthermore, the core-sampling research detected the anomalous layers which contain corals and open-sea shells in the Haneji Naikai Bay and Shoya Bay, northwestern Okinawa Island (Haraguchi et al 2012). The thicknesses of the layers are 5-10 cm. Since the coral and open-water shells live in the outside of the bay, they would have been transported by the tsunami. Distribution of tsunami sediments is important to constrain the source area of the tsunami. However, the distribution of the tsunami sediment in Okinawa Island is still unknown. Therefore, we employed coring survey to detect tsunami sediments in the southwestern Okinawa Island.

We carried out the tsunami sediment investigation in Manko of Naha city. I used Russian style Pete sampler for a sampling. Sample R1 and R2 gathered the depth of 310cm and 260cm. I divided the sample into every 5 cm. Then we measured the water content of the samples. Then the samples were sieved in a mesh-size of 63 micro. After then we calculated the mud contents. Then we measured the. particle size of the samples using sieves (mesh: 2mm, 1mm, 0.5mm, 0.25mm, 0.125mm). Finally, the depth of the core was converted to age using the sedimentation ratio of 1.4 cm/yr, which was estimated from the Pb210 isotope analysis.

The core sample R1 almost consists of mud from top to bottom. From surface to the depth of 100 cm, sand content is higher. The grayish white coarse sand is included in the depth of 0-25 cm. The grayish white medium-grained sand with patch-like inclusion of fine sand is included in the 30-45 cm. The fragments of wood are concentrated in the depth of 60-100 cm, which correspond to the age of WWII and postwar population growth, reclamation. We assumed that the concentration of fragment of wood and sand would have been caused by these events. The concentration of the sand could not be found in this core. This suggests that remarkable tsunami events did not arrived in the lake-Manko area for about 300 years.

Keywords: Manko, Tsunami Deposites, Okinawa, southern, Naha City

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A survey of tsunami sediments in Miyako Islands

Shota Shiga[1*], Mamoru Nakamura[2], Kazuhiko Fujita[2], Yasuhisa Arashiro[1], Chiaki Gushikawa[1], Masataka Ando[3], Youko Tu[3], Masanobu Shishikura[4]

[1]Faculty of Science University of the Ryukyus, [2]Facul. Science, Univ. Ryukyus, [3]Institude of Earth Sciences, Academia Si, [4]Active fault Earthq. Res. Ctr., AIST/GSJ

The 1771 Yaeyama tsunami (Meiwa-tsunami) was possibly M8 class interplate earthquake in the Ryukyu Trench (Nakamura, 2009). The transport ages of tsunami boulders, which were moved from coral reef to land by tsunamis, concentrate to five periods for 3000 years (Kawana, 1994). This suggests that the mega-tsunami occurred frequently in the south Ryukyu Trench. Thin sand layer overlying the basement of buried old house has been reported in the ruin of the Miyako-Yaeyama region. They has been interpreted as the tsunami deposit. However, there is no evidence for the tsunami deposit since the origin of the sand is unclear. Then, we employed the trench-surveys in the Miyako Island and investigated the origin of the sand layers using the analysis of foraminiferal. The survey was conducted on the day of 18-21 June 2012 at Tomori (Miyako Island), Ikema Island, and Irabu and Sawada (Irabu Island).We digged a trench about from 1m to 3m depth and observed. The silt layer with sand is distributed at the depth from 30 cm to 50 cm in Tomori. We collected 8 samples from 15cm to 110cm depth including this layer. Since layer consists of muds from 0 cm to 160 cm in Ikema Island, we could not find sand layer. In this site, we collected samples from 45cm to 155cm depth. A medium grain sand is distributed at the depth from 80 cm to 115 cm, and brown-colored fine grain sand or silt is distributed at the depth from 120 cm to 200 cm in Irabu. We collected 6 samples at the depth from 80cm to 160cm. In Sawada, the sand layer with grading from medium to coarse is distributed at the depth from 170 cm to 290 cm. We collected 9 samples from 190cm to 290cm depth. Next, we washed mud . Then, the samples separate by 2mm mesh, 1mm mesh, 0.5mm mesh, 0.25mm mesh, 0.125mm mesh and 63um mesh and we pick not more than 150 foraminiferas by from 0.5mm mesh to 1.0mm mesh at a microscope. If sample’s amounts are increasing, we divided for simple divider. In foraminifera, we divided into priority species (Calcarina, Hispida, Baculogypsina, Elphidium) and the others. In addition, we observe species for inhabiting sediment in the others. The mud content is lower and the layer contains coarse sand at the depth from 115 cm to 150 cm in Irabu. From the foraminiferal analysis, sample of 150cm depth contains

Eponides sp., Pseadorotalia sp., Lenticulina sp., Ammonia sp. and A. bicirculata. These five species live in the sediments of reef and lagoon (Uchida, 2007: Shiba, 2012). Furthermore, Lenticulina sp., Ammonia sp. and A. bicirculata were not included in Toguci Beach’s samples. This suggests that the sand at the depth of 150 cm in Irabu is transported from reef, lagoon and beach. The sand would have been tsunami sediment because the sand of reef and lagoon could not be transported to the site by the storm wave. The sand originates from sand of reef, lagoon, and beach also suggest the sand is tsunami sediment. The grading structure at the depth from 170 cm to 290 cm in the Sawada suggests that the layer is tsunami sediment. Furthermore, the bottom of the grading layer includes Ammonia sp., Cibicidoides sp., Anomalinella, Eponides sp., Pseudorotalia sp. and Ammonia sp.. In addition, Cibicidoides sp., Anomalinella, and Eponides sp. was not included in Sawada Beach’s samples. In addition, at this depth’s sample was a result of a large number of individuals that live in the shallow-water zone inside Elphidium. I mean, I can guess it deposits due to the tsunami because the sand of the beach sand and lagoon and reef are mixed and sand location where waves are difficult to reach are transported to land. Even more, sand from 290cm depth’s sample was a result of a large number of individuals that live in the shallow-water zone inside Elphidium, too. In addition, we also observed planktonic foraminifera and Ammonia sp. . We suggest to tsunami trace, too.

Keywords: tsunami sediments, foraminiferal analysis

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Movement of boulders by tsunamis or typhoon waves in the Lanyu Island, Taiwan.

Mamoru Nakamura[1*], Yasuhisa Arashiro[1]

[1]Faculty of Science, University of the Ryukyus

The eastern Taiwan region is convergent plate boundary where the collision of Philippine Sea plate and Eurasian plate is ongoing. Occurrence of M 7.5 earthquakes are estimated from the distribution of the sea floor active faults. Seismic potential for interplate earthquakes in the western Ryukyu Trench is M 8.5 (Lin et al., 2012). Few damages by historical tsunamis were reported in the old documents in Taiwan, whereas folklore about tsunami damage remains in the east part of Taiwan and Lanyu Island, southeast of Taiwan. Large boulders, which consist of fragments of coral reef and are moved by inundation of tsunamis or storm waves, are distributed on the shore of Lanyu Island.

We surveyed the distribution of boulders in the shore of Lanyu Island, and investigated whether the boulders are moved by tsunami or typhoon wave. The survey was carried out from August 31th to September 4th of 2012. Just before the survey, the typhoon 14 (TEMBIN) approached the island and caused severe damages to the infrastructure of the island. We surveyed the distribution of boulders in the western coast of the Island. The maximum run-up heights of the storm wave were 11 m in the western coast of the Island. Although the boulders whose diameters were within 2.0 m were not moved by the storm waves, the boulders whose diameters were over 2.0 m were transported by the typhoon wave. This suggests that the boulders whose diameters are over 2.0 m would be transported by the storm wave whose maximum heights were over 11 m.

The boulders are distributed in the north and east coast of the Lanyu Island. The maximum size of boulder is 6.4m x 6.1m x 2.9m. We calculated the minimum inundation depth that can transport the boulder using the formula by Kennedy et al. (2007). The calculated minimum depths by tsunami and storm waves are 3.4 m and 12.9m, respectively. The coral reef-lagoon topography does not develop along the Lanyu Island, and the distribution of the boulders is limited within 100 m from shore and within the heights of 10 m. this area corresponds to the storm area. The boulders in the Lanyu Island would not have been transported by the tsunamis but have been moved by the storm waves.

Keywords: Taiwan, tsunami boulder, typhoon, Lanyu Island