Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)


HCG31-P01 Room:Convention Hall Time:May 20 10:30-12:00

# Benthic foraminiferal faunas in the sediment into OBSs off Miyagi after 2011 earthquake of the Pacific coast of Tohoku

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After the earthquake of the Pacific coast of Tohoku with mega-tsunami on March 11, 2011, the ocean bottom seismographs (OBS) installed on the Pacific Ocean bottom off Miyagi Prefecture were recovered urgently to analyze the record (Miura et al, 2011). Unconsolidated sediment was found inside the hard hat to protect OBS, and we have analyzed the depth distribution of benthic foraminiferal assemblages.

Several OBSs were installed on the land side of Japan Trench for the natural long-term seismometry. As far as an OBS is placed in right position at sea-bottom, sediment is not easily to be injected inside the hard hat. Therefore, sediment in the hard hat was possibly brought by water flow with sediment, which was raised up in bottom-water in the OBS-arranged area (Miura, 2011). After the earthquake, it has reported that muddy sediment covers in the large area from shelf-edge to trench slope (300-5940 m in water depth) off Sanriku region (Ikehara et al., 2011) , and this sediment is assumes to be transported by low density turbidity current (Arai et al., 2011).

Foraminifera are a kind of Protista with shell, and inhabit in every sea-bottom, from brackish coastal waters to ocean floor and trenches. A lot of species live every favorite environment. Many of species are generally good depth-indicators, and, an assemblage in association with some species is recognized in a certain depth range (depth zone) to some extent. Therefore, displacement of sediment by turbidity current, for example, should be detected as an abnormal distribution of foraminiferal assemblage. On the abnormality in the OBS-installed area off Miyagi Prefecture, foraminiferal distribution reported by Matoba (1976) provides a suitable reference for the present comparative study.

The 14 samples are obtained from the OBS stations of 299-2773 m in depth range. Among six assemblages recognized in this study, five are comparable with five ones of Matoba (1976) from 220-1980 m in depth range, and another one is deeper than the Matoba's deepest station. Compared with Matoba's assemblages, those of shallower depth than ca.1500 m are almost coincident, except for a boundary of deeper assemblages at ca.2000 m of this study. Its comparable boundary of Matoba's assemblages is drawn at ca.1800 m, 200 m deeper.

This difference of faunal boundary at deeper sites suggests more large dislocation of sediment at deeper part of trench slope. We will discuss the mechanism of sediment intrusion into hard hat, origin of suspended sediment, and trigger of turbidity current, as well as magnitude of turbidity current.

Keywords: earthquake, tsunami, OBS, benthic foraminifera, turbidity current

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HCG31-P02 Room:Convention Hall Time:May 20 10:30-12:00

# Large submarine landslides in the Japan Trench: An old but new scenario for tsunami generation

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We describe in detail possible large submarine landslides, several tens of kilometers in length and width, on the trench landward slope of the Japan Trench on the basis of high-resolution topographic surveys and detailed seafloor observations. These slides stopped at the toe of the trench slope. After initial movement of the toe along a basal decollement or thrust of the trench landward slope wedge during an earthquake, the basal frictional condition(s) might change drastically from static to dynamic, thus reducing the frictional strength. As a result, rapid submarine landsliding push downward on the toe, generating large vertical and horizontal displacements for tsunamis. The thrust movement at the toe of the trench slope was probably resulting from submarine landsliding with rupture propagation. This thrust movement might be with big slips without strong seismic waves. This hypothesis could explain suitably the relation between large displacement of the thrust fault and tsunami generation by the 2011 Tohoku earthquake as well as tsunami generation by the 1896 Tohoku earthquake.

It has been believed that tsunamis are generated only by seafloor topographic change caused only by active faulting, excepting for local effects by volcanic and/or small landsliding. However, the Japanese tsunami warning system does not include the tsunami excitation scenario by submarine landsliding. In fact, in 1979, a tsunami 2?3 m in height struck Nice, France, unaccompanied by any seismic signals. This silent tsunami was considered to be generated by submarine landsliding near the Nice harbor (Dan et al., 2007). Tsunami-generating submarine landslides have been known to occur from various areas in the world (Yamada et al., 2012). Thus, all data pertaining to tsunami generation mechanisms as well as topographic changes in survey data from before to after the 2011 Tohoku earthquake should be carefully examined to improve our understanding of tsunami generation.

Some of the Tohoku people have called the silent tsunami as Yoda, which is different meaning from Tsunami. In spite of the previous people experience we forget totally the Yoda, because we believe that tsunamis should be excited only by seafloor deformation of rupture propagation. According to Yamada et al. (2011), there are many giant submarine landslides, not only in active margins as the Japan Trench, Nankai Trough, Kuril Trench, but also in passive margins as continental slope of the Atlantic Ocean, and also in volcanic islands and deep-sea fan. We must consider the basic mechanism of tsunami excitation immediately. Our tsunami early warning systems following the ever-believed tsunami excitation mechanism may be wrong.

Keywords: Submarine landslide, Tsunami, Tohoku-oki earthquake, Meiji-Sanriku earthquake tsunami

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HCG31-P03 Room:Convention Hall Time:May 20 10:30-12:00

# Mass Transfer deposits along the splay fault Nankai Trough, Kumanonada: Deformation structure and transfer direction of

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Integrated Ocean Drilling Program Expedition 333 was conducted to core a slope site (C0018) for NanTroSLIDE (Nankai Trough Submarine Landslide History) project. A stacked mass transport deposits (MTDs) recognized in 3-D seismic data in the slope basin of the megasplay fault, offshore Kii Peninsula was cored in order to establish a mass-movement event stratigraphy and analyze its rheological property to constrain sliding. Several slid sediments forming MTDs were recovered. Various types of deformation structures, which were formed during sliding were found in the MTDs intervals. The depositional timing of the MTDs sequence was constrained by biostratigraphy, paleomagnetostratography, and tephrostratigraphy. It indicates that all MTDs were formed within 1Ma.

In the area of upper slope of C0018 prominent arcuate scarps caused by submarine landslide are identified. It is supposed that those collapsed materials were sources for MTDs. To document characteristics of the scarps and MTDs of the area, detail surface and subbottom observations were conducted using Navigable Sampling System (NSS) of Atmosphere and Ocean Research Institute, Univ. Tokyo. The youngest MTD layer (MTD1) is interbeded 1.3 m bellow sea floor with 3-m thickness at C0018. In order to understand a transport direction of MTD1, 1) tracking the layer using a subbottom profiler equipped with NSS, and 2) sediment sampling for structural reconstruction of deformed layer to infer a slope sliding direction were conducted. The subbotom images acquired by NSS represent that MTD1 reveals a channeling structure extending to NW. Reoriented folding axes of deformation layers show NW-SE trending. A sliding direction of MTD1 was inferred as a perpendicular direction to the folding axes, which coincident with the channeling structure in the subbotom images. The method described above may elucidate a rheology of MTDs, and can be applied to the analysis of the other MTDs. Because the scarps distribution is along around a surface location of the splay fault, it is supposed that the surface collapses were induced by the fault activations. Thus establishing a stratigraphy of MTDs is important to understand hazardous events occurred near the surface in the great earthquake rupture zone off Kumano.

Keywords: Submarine landslide, splay fault, Nankai Trough

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# Submarine landslide structure in the lower Pleistocene slope deposits, exposed at the Miura Peninsula, central Japan.

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The Nojima Formation, a lower Pleistocene slope deposit, of the middle Kazusa Group is exposed at the northern Miura Peninsula, central Japan. In the study area, the submarine landslide deposits are observed at the horizon between 2-65 m below the YH02 tuff bed correlated with the Kd39 tuff bed (1.76 Ma: Nagahashi et al., 2000) of the Kiwada Formation of the Kazusa Group in the Boso Peninsula. We investigated the internal structure of submarine landslide deposits of the Nojima Formation based on the field observation and bored core analysis.

The Nojima Formation of the study area is divided into three units, lower, middle and upper units. The lower unit, about 50 m thick, is composed of muddy sandstones lower and alternation of sandy mudstones and mudstones upper, the middle unit, about 20 m thick, is mainly composed of muddy sandstones, and the upper unit, about 5-40 m thick, is of conglomerate lower to muddy sandstones upper, representing fining upward. The sandy mudstones of the middle unit are sharply contact with the uppermost mudstones of the lower unit. At the boundary, the mudstone is partly injected into the sandy mudstones. The injection has width's up to 40 cm and lengths up to 3 m. Strikes and dips in the middle unit represent various values, which are not in accord with those of the lower and upper units representing constant values. Total five tuff beds are correlated between the lower unit and middle unit, which indicates all horizon of the middle unit is duplicated with the lower horizon. The conglomerate of the lowermost of upper unit, eroding and covering the middle unit, is composed of mudstone, muddy sandstone and sandstone boulders.

The duplication of the middle and lower units indicate that the middle is a slide block and run onto the lower unit by submarine landslide. The middle unit is coarser than the same horizon of the lower unit, which indicates the middle unit is originated from more proximal environment than the lower. Then the upper unit is interpreted as gravity flow deposits filling the slide scar. Considering the stratigraphic relationship based on key tuffs, the heights of the landslide are estimated as up to 110 m+ thick.

Keywords: submarine landslide, lower Pleistocene, Kazusa Group, Nojima Formation, Miura Peninsula, slope deposits

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# Characteristic of submarine landslide deposit,observed and the Nebukawa coustal area

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There is Nebukawa district at the foot of a mountain of Hakone volcano somma in Kanagawa prefecture which have steep slopes near the coast. Just after the Great Kanto Earthquake of 1923, the Ohbora district was collapsed which composed Hakone volcano somma and landslide fall down around the Shiraito river. Then landslide happened same time at right behind Nebukawa station and the landslide roll up railroad station, nearby houses and train. And then the landslide reached to submarine.

At the area, Ohne lava layer distribution at nearby sea shore and Nebukawaishi lava layer distribute at over 60m above sea level. In addition volcaniclastic material layer which composed lower layer (solid lapilli tuff) and upper layer (pumice, loam) between Ohne lava and Nebukawaishi lava.

In this study, we used ultra high resolution multibeam echosounder SeaBat 7125 to high precision survey seafloor terrain. We have also dived for take rocks from seafloor.

There two-type of topographical structure, Zone-1 characterized by coarse reflection distributed parallel to the coastal topography. Zone-2 Spread of lobe structure off the coast from the coast opposite, then Zone-2 cut on Zone-1.

There rock from the lobe is a Nebukawa, which locate more than 60m above sea level. There rock derives by the landslide which occurred in big earthquake.

Keywords: Nebukawa, landslide, lobe structure

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# Experimental Study on Motion Mechanism of Submarine Landslides

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Submarine landslides are characterized by large scale and long run out distance. Besides causing tsunami, it can also cause major disasters on communication when a submarine landslide damages submarine communication cables. At present, the study on occurrence and motion mechanisms of submarine landslides is not enough. In this study, we tried to clarify the reason that submarine landslide has larger scale and longer moving distance than those occurred in continent. An apparatus to simulate submarine landslide was developed for this purpose. For each test, normal stress, shear stress and pore-water pressure of submarine landslide model acting on the apparatus bottom are measured, and friction coefficient for each test can be obtained. The paper examines the influences by landslide scale and motion velocity on the shear resistance. The result shows friction coefficient increasing when the mass of sliding body increased. Friction changed irregularly when the velocity of the sliding mass became higher, but density coefficient decreased when the velocity of the sliding mass became higher.

Keywords: motion mechanism, submarine landslide, experiment study