

# Japan Geoscience Union Meeting 2011

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MIS001-01

会場:304

時間:5月25日 14:15-14:30

## 沈み込み帯における海底斜面崩壊のモデル実験 Slope failures in analogue model experiments of subduction margins

山田 泰広<sup>1\*</sup>

Yasuhiro Yamada<sup>1\*</sup>

<sup>1</sup> 京都大学

<sup>1</sup> Kyoto Univ

Analogue model experiments that use dry granular materials commonly produce slope failures on the top free surface, and these failures can be applied to submarine slides. This talk presents some examples of slope failure events found in the models.

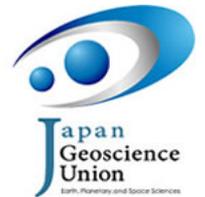
キーワード: 海底地すべり, 斜面崩壊, モデル実験

Keywords: slope failures, submarine slide, analog model

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MIS001-02

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時間:5月25日 14:30-14:45

## Along strike migration of intermittent submarine landslides at subduction margins: a geologic evidence Along strike migration of intermittent submarine landslides at subduction margins: a geologic evidence

山本 由弦<sup>1\*</sup>, 川上俊介<sup>2</sup>

Yuzuru Yamamoto<sup>1\*</sup>, Shunsuke Kawakami<sup>2</sup>

<sup>1</sup>IFREE, JAMSTEC, <sup>2</sup>Earth-Appraisal Company, Ltd.

<sup>1</sup>IFREE, JAMSTEC, <sup>2</sup>Earth-Appraisal Company, Ltd.

Ancient examples of submarine landslides exposed in the Pleistocene Chikura Group represents the lateral migration style of intermittent submarine landslide. The submarine landslide in the Pleistocene Chikura Group was triggered by earthquake induced liquefaction occurred approximately 2 Ma. Although the deposit can be traceable over 5 km based on the key-tephra (HF) tracing, we identified the evidence of lateral variation of sliding ages. In the central part, coherent layers and the key tephra, HF, overlay the slide deposit (HF overlays about 4 meters above the top of the slide sediment). In the westernmost part, however, the HF was included inside the slide deposits as blocks. The HF overlays about 2 meters above the slide deposit in the intermediate part. This is the geologic evidence indicative of the lateral migration of intermittent submarine landslides, which can be correlated to the migration style identified in the physical models (Yamada et al., 2010).

キーワード: submarine landslide, liquefaction, earthquake, accretion

Keywords: submarine landslide, liquefaction, earthquake, accretion

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MIS001-03

会場:304

時間:5月25日 14:45-15:00

## 南海トラフ檜野岬海丘において発見された厚さ70mの海底地すべり体の構造 Anatomy of a thick (~70 m) submarine land slide discovered at Kashinozaki Knoll in the Nankai Trough

山口 飛鳥<sup>1\*</sup>, Song Bora<sup>2</sup>, Henry Pierre<sup>3</sup>, 金松 敏也<sup>5</sup>, Kyaw Thu MOE<sup>5</sup>, the Expedition 333 Scientists<sup>5</sup>  
Asuka Yamaguchi<sup>1\*</sup>, Bora Song<sup>2</sup>, Pierre Henry<sup>3</sup>, Toshiya Kanamatsu<sup>5</sup>, MOE Kyaw Thu<sup>5</sup>, Scientists the Expedition 333<sup>5</sup>

<sup>1</sup> 東京大学, <sup>2</sup>Rice University, <sup>3</sup>CEREGE, <sup>4</sup> 海洋研究開発機構, <sup>5</sup>IODP

<sup>1</sup>The University of Tokyo, <sup>2</sup>Rice University, <sup>3</sup>CEREGE, <sup>4</sup>JAMSTEC, <sup>5</sup>IODP

The IODP Expedition 333, a part of NanTroSEIZE project, was operated during December 2010 to January 2011. Three sites including subduction input (Sites C0011 and C0012) and submarine landslide (C0018) were drilled. Site C0012 is located at the top of Kashinozaki Knoll, basement high of the northernmost part of the Philippine Sea Plate in off Kumano region in the Nankai Trough. From 15 to 85 m CSF of Hole C0012C, a steeply-dipping interval (dipping angles of 40-70 degrees to southeastward) probably correspondent with a thick landslide (slump) is discovered. We show the anatomy of this landslide based on the review of shipboard structural, litho- and magneto-stratigraphical, geochemical, and physical property measurement.

MIS001-04

会場:304

時間:5月25日 15:00-15:45

## A new record of submarine landslide history in the Nankai accretionary wedge: Results from IODP Expedition 333

## A new record of submarine landslide history in the Nankai accretionary wedge: Results from IODP Expedition 333

Michael Strasser<sup>1\*</sup>, Pierre Henry<sup>2</sup>, Toshiya Kanamatsu<sup>3</sup>, IODP Exp. 333 scientists<sup>4</sup>

Michael Strasser<sup>1\*</sup>, Pierre Henry<sup>2</sup>, Toshiya Kanamatsu<sup>3</sup>, IODP Exp. 333 scientists<sup>4</sup>

<sup>1</sup>MARUM, University of Bremen, Germany, <sup>2</sup>CEREGE - College de France,, <sup>3</sup>JAMSTEC, Yokosuka, <sup>4</sup>IODP

<sup>1</sup>MARUM, University of Bremen, Germany, <sup>2</sup>CEREGE - College de France,, <sup>3</sup>JAMSTEC, Yokosuka, <sup>4</sup>IODP

Here, we present results from Integrated Ocean Drilling (IODP) Expedition 333, which drilled and cored a Pleistocene-to-Holocene stratigraphic succession of a slope basin seaward of a margin-dominating out-of-sequence thrust (termed megasplay) in the Nankai accretionary wedge, offshore the Kii Peninsula, southwest Japan. The slope-basin represents the depocentre for downslope sediment transport from various sources such as the hanging-wall block of the megasplay, anticline structures within the accretionary prism and the slope apron sedimentary cover. The stratigraphic succession comprise stacked mass-transport deposits (MTDs), including an up to 150 m thick MTD, as identified in 3D reflection seismic data. Continuous coring to 315 meter depth at a location where the MTD bodies wedges-out and where basal erosion by mass-transport events is minimal, reveal a nearly complete stratigraphic succession recording more than 1 Million years of the submarine landslides history in this active tectonic setting.

We present D/V Chikyu shipboard results from IODP Site C0018, including litho- bio- magneto- and tephra- stratigraphy and physical property data. Six MTDs of thickness ranging from 50 cm to 60 m at the drill site were identified from visual core description and X-ray CT-scans. The thick MTD is the oldest and its stratigraphic position coincides with a lithological transition between a sandy turbidite sequence below and ash bearing hemipelagites comprising several MTDs above. The deformation style of these MTDs appeared heterogeneous, with intervals of remoulded sediments and intervals inferred to retain original, coherent bedding. Shear zones and faults have been identified in the lower part of the MTDs and, in three occurrences the base of the MTD is defined by a shear zone within fine-grained sediments. A thick sandy ash layer attributed to a cataclysmic eruption on Kyushu Island dated 1.05 Ma was found immediately below the thick MTD. We hypothesize that part of the ash layer was characterized by excess pore pressure and that liquidization within this layer during earthquakes is one mechanism by which submarine landslides could be triggered in subduction zones.

IODP Exp. 333 Scientists:

Kyaw, M. (JAMSTEC, JP); Alves, T. (Univ. Cardiff, UK); Bauersachs, T. (Christian-Albrecht-Univ., Germany); Daigle, H. (Rice Univ., USA); Ekinci, K. (Univ. Missouri, USA); Gao, S. (Univ. Nanjing, China); Garcon, M. (CEREGE, France); Kawamura, K. (Fukado Geol. Inst., Jp); Kitamura, Y. (JAMSTEC, Jp); Laberg, J.S. (Univ. Tromso, Norway); Lee, G. (Pukyong N. Univ., Korea); Lee, Y. (Korea Inst. of Geosci and Min. Resources); Lu, Y. (Univ. Alabama, USA); Marcaillou, B. (Univ. Antilles e. Guayne, France); Matsubayashi, O. (AIST Tsukuba, Jp); Nagahashi, Y. (Fukushima Univ., Jp); Novak, B. (W. Washington Univ., USA); Saito, Y. (Doshisha Univ., Jp); Satoguchi, Y., (Lake Biwa Museum, Japan); Sreaton, E. (Univ. Florida, USA); Scudder, R. (Boston Univ. USA); Yamaguchi, A. (Univ. Tokyo, Jp)

キーワード: IODP, NanTroSLIDE, Nankai Trough, Submarine Landslides, Mass-transport deposits, slope basin sediments

Keywords: IODP, NanTroSLIDE, Nankai Trough, Submarine Landslides, Mass-transport deposits, slope basin sediments

MIS001-05

会場:304

時間:5月25日 15:45-16:00

## Stagnation of lithification owing to shear stress in slope basin, Kumano, southwest Japan

坂口 有人<sup>1\*</sup>, 川村 喜一郎<sup>2</sup>, 芦 寿一郎<sup>3</sup>, 村山 雅史<sup>4</sup>

Arito Sakaguchi<sup>1\*</sup>, Kiichiro Kawamura<sup>2</sup>, Juichiro Ashi<sup>3</sup>, Masafumi MURAYAMA<sup>4</sup>

<sup>1</sup> \_\_, <sup>2</sup> \_\_, <sup>3</sup> \_\_, <sup>4</sup> \_\_

<sup>1</sup>IFREE/ JAMSTEC, <sup>2</sup>Fukuda Geological Institute, <sup>3</sup>AORI/ Univ. Tokyo, <sup>4</sup>Center for Advanced Marine, Kochi Univ.

The forearc, slope and trench basins and accretionary prisms are developed in Kumano area where is formed by subduction of the Philippine Sea plate to the northwest beneath southwest Japan. The accretionary prism growth during geologic time period, and many landslides are scattered at slope basin. The stability of the slope basin sediment will depend on geotechnical property of sediment. We investigated physical property of the surface sediment of various sedimentation settings at Kumano area.

Twelve piston and gravity core samples, 0.3 to 5 m in core length were taken from cover sediment of the Miura knoll, Kumano forearc basin, slope basin, small pockmark basin and Nankai trough. The electric resistibility is measured at 2 to 10 mm intervals, and the vane shear test has been carried out at 5 to 30 mm intervals. The electric resistibility, depend on seawater content is an indication for porosity of sediment.

In the result, the electric resistibility and shear strength are increase with depth in all sites, however the increase ratio varied in sedimentation setting. High increase ratio was found at cover sediment of the Miura knoll where the sedimentation ratio is likely very slow. To avoid from time-effect of dewatering and sedimentation ratio, we compared between electric resistibility and shear strength. The shear strength increases with electric resistibility, and the ratio is anywhere almost the same, except the slop and pockmark basin sediments. The strength of slope basin sediment is much smaller than the others basin sediment though similar electric resistibility. The strengthening of the sediment may depend on not only time and porosity but also formation of clay mineral structure. The slope sediment may undergo shear stress in any time, and this probably causes stagnation of formation of clay mineral structure.

キーワード: 南海, 堆積物, 強度, 粘土鉱物組織

Keywords: Nankai, Sediment, strength, Clay mineral structure

MIS001-06

会場:304

時間:5月25日 16:30-16:45

## Characteristics of slump units offshore Shimokita: a key to solve ground instability factor in gentle continental slope Characteristics of slump units offshore Shimokita: a key to solve ground instability factor in gentle continental slope

森田 澄人<sup>1\*</sup>, 中嶋 健<sup>1</sup>, 花村泰明<sup>2</sup>

Sumito Morita<sup>1\*</sup>, Takeshi Nakajima<sup>1</sup>, Yasuaki Hanamura<sup>2</sup>

<sup>1</sup> 産業技術総合研究所 地圏資源環境研究部門, <sup>2</sup>JX 日鉱日石開発株式会社

<sup>1</sup>AIST-GREEN, <sup>2</sup>JX Nippon Oil & Gas Exploration

The origin of ground instability leading to submarine landslides has not yet been fully clarified. In general, landslides on land are considered to be caused by changes in the groundwater level or hydraulic gradient due to heavy rains, or the related rapid rise in pore pressure, because such phenomena decrease the frictional properties of the ground. But, the same is not true for landslides that occur in the ocean, where seawater saturates the ground below the sea floor. The behavior of the pore fluid may change the pore pressure and cause ground instability related to submarine landslides. As a result of analysis on a 3D seismic survey of Sanriku-oki basin off Shimokita Peninsula, Japan (METI fundamental seismic survey 2008, Sanriku-oki 3D), we revealed a number of typical deformations due to slumping and the related dewatering structure in the Pliocene and younger formations. The slumping was generated primarily by layer-parallel slip, which seems to have occurred on acoustically typical layers on very gentle continental slope. The formation of the slumping and the dewatering structures is considered strongly related to fluid circulation in heterogeneous sedimentary sequence, which seems to directly lead to creation of slip plane of the slumping. We are focusing on those deformations of the slumps and the dewatering structures as a key to solve submarine ground instability factor.

キーワード: 3D seismic survey, slump, dewatering structure, slip plane, ground instability factor

Keywords: 3D seismic survey, slump, dewatering structure, slip plane, ground instability factor

MIS001-07

会場:304

時間:5月25日 16:45-17:30

## 房総 TTT 三重点上盤の大規模重力崩壊：ROV による研究の成果 Large-scale gravity collapse of the Boso TTT-triple junction hanging wall: ROV study results

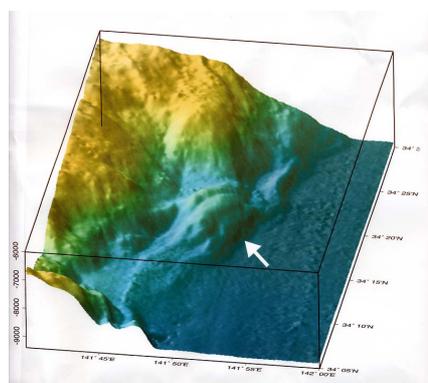
小川 勇二郎<sup>1\*</sup>

Yujiro Ogawa<sup>1\*</sup>

<sup>1</sup> 東電設計株式会社

<sup>1</sup>Tokyo Electric Power Services Co., Ltd.

A TTT-triple junction is unstable unless the direction parallels one of the trenches. Boso example is the only case for TTT but displays very systematic history of gravity collapse, continuing for a long time but remarkable in recent years. The junction must have been far SE off than at present, and has been eroded and retarded to NW by gravity collapse due to the instability of the triangle area, probably as a consequence of the NW-ward change of movement of the Philippine Sea plate along the oblique subduction of the Sagami trough. One of the direct lines of evidence is the finding of middle Miocene fossil-bearing mudstone from the large-scale gravity slide deposits just on the junction. Submersible observation and collection of the samples made sense for explanation that the Miocene to present zonal structure of accretionary prisms and related sedimentary basin deposits is now largely collapsed in various scales, particularly on the NW side hanging wall of the junction. NE-trending normal faults in the surface might be the products of horizontal stretching on the North American plate side. Change of the submarine canyons from NW-SE to N-S is also the results of this instability. The paleoseismology, paleotsunamology and field observation in the Boso-Miura Peninsulas are also supporting these stories. Some of them may be related to the total subduction activity simultaneously linked earthquakes from the Nankai trough to Sagami trough.



キーワード: 房総, 三重点, 重力崩壊, 古地震学, ROV

Keywords: Boso, triple junction, gravity collapse, paleoseismology, ROV

MIS001-08

会場:304

時間:5月25日 17:30-17:45

## 海底活断層上に発生した海底地じりが巨大津波の原因か？

Underwater landslides and slumps observed along active submarine faults ? a possible source of a devastating tsunami?

松本 剛<sup>1\*</sup>

Takeshi Matsumoto<sup>1\*</sup>

<sup>1</sup> 琉球大学

<sup>1</sup> University of the Ryukyus

The author would like to show some examples of the results of offshore studies on underwater landslides and slumps along active submarine faults which might be the origin of devastating tsunamis on the adjacent coastal areas.

Case-1: the 1998 Papua New Guinea Tsunami

The northern coast of Sissano Lagoon and Town of Aitape, Sandaun Province of Papua New Guinea enormously suffered from a M7.0 earthquake, which was followed by a large-scale tsunami on 17th 1998. 2,200 fatalities were recorded due to the run-up of the tsunami in Aitape and Sissano areas. The area is characterised by a plate convergent margin along the Wewak Trench where the North Bismarck Sea Plate subducts towards the mainland Papua New Guinea.

The precise topographic survey revealed that an amphitheatre NNE of Sissano Lagoon is associated with a ENE-WSW-trending knoll just off the basin (Pop-up Block = PUB). The western half of the amphitheatre is characterised by erosion by small channels perpendicular to the topographic contour line whilst the eastern half by sediment deposition lobe parallel to the strike of the steep slope. This amphitheatre seems to be most active and with most recent seafloor deformation according to the topographic feature.

The following events were identified on the amphitheatre and PUB areas during the seafloor reconnaissance surveys.

(1) En echelon cracks/fissures on the sediment with sharp edges on both sides were located along the headwall of the amphitheatre. These are apparently "crown cracks", indicating the tensile stress applied recently due to a slump on the headwall.

(2) Living mussel and tube-worm colonies were observed on the slope, indicating a cold seepage of nutrient-rich water along a crack.

However, bio-turbated areas were also observed widely away from these active events. Therefore the possible landslide which generated the large-scale tsunami might be due to the movement of the cohesive surface sediment triggered by the mainshock.

Case-2: the 2006 Java earthquake and tsunami

A Mw 7.7 earthquake and subsequent large-scale tsunami occurred on 17th July 2006 off the southern coast of Java Island, Indonesia. A maximum of 7.7 m inundation height was recorded in Pangandaran on the southern coast of Java, according to the field survey just after the tsunami (Tsuji et al., 2006). However, since there are few residents who noticed the earthquake tremors, the earthquake may possibly be so-called "tsunami earthquake". The aftershocks from July to September occurred on the fore-arc area and their CMT solution suggests the predominant north-south tensile stress. R/V MIRAI passed the aftershock area in 2004 and 2005 with continuous multi-beam bathymetric survey. The processed topographic map shows a lot of amphitheatres with the scale of 8-20 km along the fault scarps. Convexity landforms are located below the footwall of the amphitheatres, apparently the relics of an underwater landslide, and their relative elevation exceeds 1000 m in maximum. This area is characterised by the south-eastern extension of Mentawai Fault and its associated minor faults ranging from the Sumatra fore-arc area. The observed amphitheatres and relics of underwater landslides are located along the active faults. Considering that the tsunami wave height distribution is concentrated on a specific narrow area compared with the scale of the main-shock, the main-shock possibly triggered underwater landslides on these amphitheatres and the slides generated a large-scale tsunami.

キーワード: 海底地じり, スランプ, 海底活断層, 津波

Keywords: underwater landslide, slump, underwater landslide, tsunami

MIS001-09

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時間:5月25日 17:45-18:00

## 細粒な海底斜面崩壊堆積物の認定とその意義

## Recognition and importance of fine-grained slope failure deposits for deep-sea paleoseismology

池原 研<sup>1\*</sup>

Ken Ikehara<sup>1\*</sup>

<sup>1</sup> 産業技術総合研究所地質情報研究部門

<sup>1</sup> Geological Survey of Japan, AIST

海底の地震発生履歴の検討においては斜面崩壊堆積物が利用される場合がある。過去の地震のすべてに海底斜面が反応し、斜面崩壊が起き、常に泥の降り積もる海底であっても、崩壊堆積物のすべてが保存されるかどうかの検討は必要である。相模湾西部では伊豆半島東方沖地震に伴う混濁流の発生が報告されているが、これによる明瞭な砂質タービダイトの形成は認められない。また、おそらく堆積量が少ない関係で明瞭なタービダイト泥も確認できない。一方、泥質物からなる混濁流でも堆積量が多ければ、紀伊半島沖地震時の海溝斜面の小海盆での例のように厚いタービダイト泥がたまり得る。スマトラ沖、熊野沖、別府湾の例などから、タービダイト泥と通常時の半遠洋性泥ではその物性や粒度・粒子組成が異なることがわかってきた。海底堆積物コアの詳細な検討は今後より細粒な斜面崩壊堆積物の認定を可能にする可能性がある。

キーワード: 海底斜面崩壊, タービダイト, 地震, 古地震, 海底堆積物

Keywords: slope failure, turbidite, earthquake, paleoseismology, marine sediment

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MIS001-10

会場:304

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## 総合討論 Discussions

山田 泰広<sup>1\*</sup>

Yasuhiro Yamada<sup>1\*</sup>

<sup>1</sup> 京都大学

<sup>1</sup> Kyoto Univ.

本セッションにおける講演を総括し、有機的に結びつけるための総合討論を行う。