

Japan Geoscience Union Meeting 2011

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HCG036-01

Room:202

Time:May 24 10:45-11:00

Current status and issues of grain-size analysis using dynamic digital image method for sediment

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Grain-size analysis is fundamental to sedimentology, but despite technological advances in lab instruments, grain-size analysis is still slow and heavy. Most approaches to grain-size analysis of sediment have utilized mechanical sieving, settling through a column of water or laser diffraction. The dynamic digital image analysis is the most efficient method for grain size and particle shape measurement of sediment because of the wide measuring range from silt to pebble size grain at the same time. In this presentation, we would like to review about current status and issues of grain-size analysis using dynamic digital image method for sediment for example data from the Horiba CAMSIZER at Geological Survey of Japan, AIST.

Keywords: current status and issues, grain-size analysis, dynamic digital image method, sediment, particle shape

HCG036-02

Room:202

Time:May 24 11:00-11:15

Pleistocene forearc sedimentation during active uplift of the Japanese South Alps

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The South Alps of Japan or Akaishi Mountains has been rapidly uplifted from ca. 1 Ma due to subduction of the Philippine Sea Plate underneath the Eurasian Plate and related collision of the Izu-Ogasawara arc with the main island of Japan. Synchronously with this rapid uplift, depositional environments in forearc basin around the South Alps largely varied. Previous sedimentological studies in both onshore and offshore fields (Muto, 1985, J. Geol. Soc. Japan; Saito and Masuda, 1996, Sedi. Geol.; Takano et al., 2009, J. Geograph.) described that the Lower Pleistocene Kakegawa Group was deposited with distinct marine transgression, followed by sedimentation of the Middle Pleistocene Ogasa Group that unconformably covers the underlying Kakegawa Group with significant submarine fan progradation. In this contribution, three-dimensional seismic reflection interpretation in off Tokai area reveals that (i) the Kakegawa Group became folded under compressional stresses after its deposition and subsequent unconformable covering of the Ogasa Group occurred on the folded Kakegawa Group, and (ii) the lower and upper sequences of the Ogasa Group have sediment waves showing north-northeasterly and northwesterly paleocurrent directions, respectively. Based on these new results, we discuss how the Pleistocene forearc basin in off Tokai area was filled during active uplift of the South Alps. This contribution is a study as part of MH21 Research Consortium.

Keywords: Off Tokai area, Pleistocene forearc basin, Kakegawa Group, Ogasa Group, compressional folding, sediment wave

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HCG036-03

Room:202

Time:May 24 11:15-11:30

Decrease of continental weathering in the Early Triassic in the Tethyan Himalaya, central Nepal

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The geochemistry of mudstones to estimation for continental weathering in the central area of Nepal, Tethyan Himalaya, present the key of the Early Triassic climate change, around early Olenekian (Smithian). High value of chemical weathering indexes in the Griesbachian - Dienerian are sharply decreased from the late Dienerian to middle Smithian, which suggests the climatic episode characterized by abrupt decrease of continental weathering suggesting predominance of arid or cool climate. Because the contemporaneous radiation of ammonite fauna was reported previously, presented arid or cool climate episode indicates that the large climatic change could be one of the important controls in Early Triassic environment. The climatic change is considered to contribute to emerge from "super hot house" subsequent from the duration of Permian - Triassic boundary aftermath.

Keywords: Triassic, continental weathering, climatic change

HCG036-04

Room:202

Time:May 24 11:30-11:45

Organic geochemical aspects of hyperpicnite-like sedimentary sequence in the Neogene Kawabata Formation, Hokkaido, Japan

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The Neogene Kawabata Formation, which is located in Yubari area of central Hokkaido, is characterized by turbidite facies that consist of alternations of conglomerate, sand, and mud stones. The Ishikari Trough has been formed with N-S direction in Central Hokkaido region during 15 Ma in the Middle to Late Miocene. The Kawabata Formation is thick sediments filled with the Ishikari Trough. We perform sedimentological and geochemical investigations of the Kawabata Formation, in order to give understandings for transport and sedimentation of terrigenous materials as well as material cycling in neritic to hemipelagic environments. In this presentation, we focus organic geochemical results in the hyperpicnite-like sedimentary sequence described in the Kawabata Formation. Furthermore, we discuss the biogeochemical interaction between land and ocean such as the relationship between higher marine primary production and efficient transport of terrigenous materials by flood system.

We discovered a peculiar sedimentary sequence across about 50 cm depths in an outcrop of the Higashiyama-gawa route in Yubari. This sedimentary sequence consists of homogenous mudstone, coarsening-upward sandstone, sandstone intercalated thin layers of plant fragments, sandstone randomly contained plant fragments, fining-upward sandstone, sandstone with horizontal lamination, and homogenous mudstone, from lower to upper layers. This sequential pattern is almost similar to that in hyperpicnite. Total organic carbon content (TOC; %) was found to increase remarkably from sandstone layers with plant fragments to horizontal lamination layer, which is concordant with hyperpicnite (Yoshida et al., 2009). Organic geochemical characteristics for biomarker were followings, 1) concentrations of coniferous biomarker were remarkably higher in homogenous mudstone below the sandstones and coarsening-upward sandstone, 2) concentrations of degraded biomarkers originated from angiosperm were higher in sandstone layers with plant fragments, and 3) maturity levels were significantly lower in sandstone layers with plant fragments. From these results, we conclude that this sedimentary sequence was hyperpicnite. Furthermore, we found that concentrations of biomarkers derived from marine phytoplankton remarkably increased with increasing those of terrigenous biomarkers in homogenous mudstones above the sandstones. This fact suggests that marine primary production was activated by efficient transport of terrigenous materials by flood system in the Ishikari Trough during Late Miocene. These results are important for understanding material cycling and biogeochemical processes with Neogene-order time scale.

Keywords: Neogene paleoceanography, Sedimentary system, Hyperpicnal, Land-ocean interaction, supply of terrigenous material, material cycling in neritic environment

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HCG036-05

Room:202

Time:May 24 11:45-12:00

Age estimation of a turbidite layer in surface deposit of the Enshu Trough, off-Tokai district

Masaaki Shirai^{1*}, Takuma Ito², Yuichi Niwa³, Akiko Omura³, Toru Wakabayashi³

¹Tokyo Metropolitan Univ., ²Nagano City Museum, ³Univ. of Tokyo

Tokai district, central Japan is located near the Nankai-Suruga Trough and has been attacked by the Tokai earthquakes repeatedly. These earthquakes often induced submarine landslides and formation of turbidites. A 7 cm-thick distinct turbidite layer was intercalated in the surface hemipelagite obtained from the Enshu Trough at 1500m water depth. Although mass accumulation rate (MAR) of hemipelagic component and age of the sand layer were estimated based on dry bulk density, grain size distribution, and depth of Cs-137 appearance horizon, enough accuracy of age estimation was not obtained due to shallow position of appearance horizon and low activity of Cs-137. We compare result of new estimation of depositional age of the turbidite using Pb-210 dating with the Cs-137 using estimation.

Keywords: turbidite, hemipelagite, Pb-210 dating, Cs-137, Anse-Tokai Earthquake

HCG036-06

Room:202

Time:May 24 12:00-12:15

Effect of the storm waves on the distribution of sediments on the reef at northern Ryukyu Islands

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Coral reefs form dynamic wave-resistant structures built by the skeletons of living organisms, and absorb the energy of breaking waves that are produced by storms and tsunamis. Because the most active growth is in the wave-breaking zone, reefs form linear structures facing waves, often parallel to shorelines, protecting them from erosion. Only scleractinian corals are able to build these structures. Storm surge in the Ryukyu Islands is the abnormal rise in water level caused by wind and pressure forces of a typhoon. Coral reefs are subject to mortality from a variety of wave erosion whose impact is most serious at reef edges, and removed reef blocks are transported them as boulders to the reef flat by shoring currents.

Coral boulders or cobbles without mechanical abrasion and smoothing are generally found on reef flats in the Ryukyu Islands. No large tsunamis have attacked the northern Ryukyu Islands for the last 200 years and hence they were highly likely deposited by the storm waves. Although previous works focused on the distribution of boulders (Goto et al., 2009) or cobbles (e.g. Kan et al., 1994), there is no systematic study that investigated the characteristics and distribution of the reef sediments (sand to boulder size) transported and deposited by storm waves. Thus, we investigated the sediment distribution on the reef and compared to the distribution of the storm wave forces.

Field work was conducted in the Yo coast, north-eastern Amami-Oshima Island of Kagoshima Prefecture. Boulders deposited on the reef crest, distributed within 200 m from the reef edge as an exponentially fining landward deposit. Although Amami-Oshima Island is about 300 km far from Okinawa Islands, central Ryukyu Islands, the boulders were commonly deposited on the similar distribution trend. This suggests that storm waves which have attacked to these islands on the Pacific Ocean side were similar in the maximum intensities, and that the landward limit of boulders might be estimated as the maximum transport force of storm waves. The bottom sediments at the landward half of the moat were composed of coral sands, whereas offshore half of the moat is composed of Sargassum, rubbles and gravels. Reef rocks were exposed on the floor of the reef crest, and many coralline boulders with >1 m in long axis were deposited. We found that maximum sizes of the sediments on the reef of Yo coast shows exponentially fining trend with distance landward from the reef edge. This trend is well consistent with the distribution of the storm wave force on the reef. Therefore, we infer that the storm wave force is one of the major factors to determine the sediment distribution on the reef.

Keywords: Amami-Oshima, coral reef, boulder, reef sediments, storm wave

HCG036-07

Room:202

Time:May 24 12:15-12:30

Correlation of tsunami deposits based on temporal change in coastal environment, eastern Hokkaido

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¹ISV, Hokkaido University, ²Earlham College

Because Hokkaido and the Kuril Islands lack an extensive historical record, geologic studies of paleotsunami deposits are the most reliable method of estimating the frequency and magnitude of past tsunami events in this area.

Eight sand layers in 3000 years of coastal deposition on the eastern coast of Hokkaido provide the best evidence for frequency and magnitude of the tsunami hazard faced by this area. However, correlation of these sand layers from one location to the next, or even within one location, is difficult?the regional tephra stratigraphy provides poor resolution for the time of interest, and radiocarbon also often fails to provide adequate resolution. Here we couple mineralogical analysis of the deposits with high-resolution granulometry to provide another tool for correlation on this coast.

Paleotsunami deposits are often correlated based on thickness, depositional structures, tephrochronology, and radiometric dates. In this area, however, the depositional environment (a hummocky marsh) creates microtopography that makes both thickness and depositional structures unusable for large-scale correlation. The available marker tephra in the area are: Tarumae-a tephra (Ta-a, AD1739), Komagatake-c2 tephra (Ko-c2, AD1694), Tarumae-b tephra (Ta-b, AD1667), Baekdu-san Tomakomai tephra (B-Tm, ~1000 yr BP), and Tarumae-c tephra (Ta-c, ca. 2700 yr BP). These are insufficient for chronology before the 17th century. Equally, with approximately one layer every 350-400 years, even radiocarbon often cannot provide adequate resolution to be used for correlation of these sand units.

In this study we attempt to correlate sand layers using particle size distribution, diatom assemblages, and the chemical composition of volcanic glass and orthopyroxene. Particle size distributions vary with layer and subunit depending on hydraulic conditions and on source material. Sand layer composition also varies with source material. In particular, pumice and orthopyroxene can be used to infer different source areas on this coastline. Diatom assemblages can also be used to help explain the source of the sand.

We sampled sand layers in two marshes, near Urahoro and Nemuro, using a Geoslicer. Particle size distribution within each layer was measured with a Retsch Camsizer. Minerals and diatoms were identified under a light microscope. Major element composition of volcanic glass and orthopyroxene was determined with an EDS.

Near Urahoro, eight tsunami layers (U-1 to U-8) occur between Ta-b and Ta-c. Four layers (U-1, U-2, U-5, and U-8) can be correlated by their particle size distribution. Depositional structures vary greatly in the area, probably because of microtopography. U-1 is distinguishable from others by the presence of orthopyroxene, possibly suggesting that U-1 was deposited during a different season. Sand samples taken from inland sites contain more pumice fragments than samples from seaward sites, suggesting density separation during transport.

In Nemuro, one tsunami layer (N-1) occurs above Ta-a, and seven layers (N-2 to N-8) between Ko-c2 and Ta-c. Tsunami layers contain 90% freshwater diatoms and 5-10% brackish, indicating that the tsunami waters originated from the diatom-poor sea and flowed through brackish and freshwater areas. Younger layers contain more marine and brackish diatoms, suggesting land subsidence or coastal erosion.

Precise particle size distributions and compositional analysis strengthen the correlations of tsunami layers. Grain materials and diatom assemblages enable interpretation of tsunami deposit source and the geological and hydrological setting at the time of the tsunami.

Keywords: Tsunami deposits, correlation, particle size distribution, grain materials, Kuril Trench

HCG036-P01

Room:Convention Hall

Time:May 24 14:00-16:30

Sr-Nd isotopic signatures indicate the provenance and depositional process of loams in the Tottori coastal dune

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Isotopic analyses of strontium and neodymium suggest that layers of loam intercalated in dune sand on the Japan Sea coast at Tottori, western Japan, mainly consist of Asian dust particles from China. An outcrop exposure shows a succession of late Pleistocene dune sand, a lower loam layer, Daisen-Kurayoshi Pumice (DKP; 50~55 ka or older), an upper loam, Aira-Tn tuff (c. 30 ka), and Holocene dune sand, in ascending order. Bulk samples of the loam layers show an upward increase in $^{87}\text{Sr}/^{86}\text{Sr}$, suggesting that the contribution of Asian dust increases upward. The Sr isotopic values also suggest a greater contribution of Asian dust in the silt fraction than in the bulk sample. Asian dust transported by westerly jet from the Taklamakan or Gobi desert is the main constituent of the upper part of the lower loam, of which isotopic values of silicate portion is isotopically identical to those of those desert sand ($^{87}\text{Sr}/^{86}\text{Sr}$, 0.717~0.719; ϵ_{Nd} , -9.5~-9.4). In contrast, the Sr and Nd isotopic values of DKP ($^{87}\text{Sr}/^{86}\text{Sr}$, 0.705; ϵ_{Nd} , -2.6~0.6) are close to those of the volcanic rocks of Mt. Daisen, which is regarded as the source of the tephra. The isotopic signature suggests that Asian dust also have contributed to the upper part of the upper loam layer. The upward increase of $^{87}\text{Sr}/^{86}\text{Sr}$ within each of the loam layers suggests that the contribution of Asian dust increased as the proportion of reworked deposits from the underlying layer (dune sand or DKP) decreased by burial. In contrast, $^{87}\text{Sr}/^{86}\text{Sr}$ in DKP shows little vertical change, suggesting very rapid deposition without entrainment of the underlying lower loam layer.

*:epsilon

Keywords: Eolian dust, Loess, Coastal dune, Strontium and neodymium isotopes

HCG036-P02

Room:Convention Hall

Time:May 24 14:00-16:30

Depositional processes of deep-sea sediments using organic matter analyses, examples from the Kumano Trough

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Deep-sea turbidite is useful tool for long-term paleoseismicity analysis. However turbidity currents occur with not only slope failure by earthquake but also flood and storm. The purpose of this study was to examine depositional processes of turbidite using organic matter analyses.

Study area is in the Kumano Trough, which lies off the Kii Peninsula of central Japan. Sediment cores are from the basin floor (1870 to 1990 m water depth) of western part and submarine canyon (Anoriguchi Canyon, 1660 m water depth) of eastern part of the Kumano Trough. Sediment cores are composed mainly of dark-olive silt layers (hemipelagite) with interbedded turbidites. The turbidite layers are 1 to 15 cm thick. Shirai et al. (2010) revealed that turbidites in western part of the Kumano Trough were deposited by flood due to the 19th century Tostukawa flood (1889) and the Isewan Typhoon (1959). Vertical distributions of ¹³⁷Cs in sediment core from the Anoriguchi Canyon implies that the appearance horizon of ¹³⁷Cs were located at 12-14 cm below sea floor. The turbidite was deposited before 1954 year, because the turbidite is below the ¹³⁷Cs appearance horizon.

Total organic carbon contents and stable organic carbon isotope values were measured using an elemental analyzer and a mass spectrometer of the Atmosphere and Ocean Research Institute, the University of Tokyo. We also observed sedimentary organic matter using reflected light and fluorescence microscopy.

Results of stable carbon isotope analysis showed that terrigenous organic carbon increase above Isewan typhoon and Tostukawa flood induced turbidite in western part of the Kumano Trough. While terrigenous organic carbon does not increase above turbidite in the Anoriguchi Canyon. The turbidite was considered to deposited by failure of canyon head or slope.

Reference: Shirai, M., Omura, A., Wakabayashi, T., Uchida, J. and Ogami, T., 2010, Depositional age and triggering event of turbidites in the western Kumano Trough, central Japan during the last ca. 100 years. *Marine Geology*, 271, 225-235.

Keywords: deep-sea sediment, turbidite, organic matter analyses, Kumano Trough

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HCG036-P03

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Entradichnus ichnofacies in eolian dune strata (Djadokhta Formation) at Tugrikiin Shiree, southern Mongolia

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Trace fossils provide significant information on the paleoenvironment in which the trace formed. The paleoenvironmental usefulness of the trace fossils is applicable not only to marine strata but also to terrestrial deposits. Eolian sand dune deposits of the Upper Cretaceous Djadokhta Formation at Tugrikiin Shiree, southern Mongolia, yield numerous trace fossils belonging to Entradichnus ichnofacies, which contains Entradichnus meniscus, Skolithos isp, and other ichnospecies. This presentation describes the type ichnospecies, the trace fossil Entradichnus meniscus, a long unlined and unbranched trail that is filled with meniscate laminae and occurs characteristically in positive epirelief. The trail is straight to gently meandering, parallel to the fore-set laminae of the eolian dunes, and their long axes shows predominantly parallel to the depositional dip of the cross-stratification laminae. In addition, almost all the crescentic internal laminae of the trail show concave down-dips. These features indicate the paleoecology of the trace makers, namely the trails were produced beneath the slipface of eolian dunes by the downward burrowing of the trace-makers. Previous studies also reported very similar occurrence mode of the trace fossil from the Jurassic eolian dune deposits in North America. Therefore, the preferred orientation of the trace fossil might be a common feature in arid eolian dune deposits at least during the Jurassic and Cretaceous, and possibly reflecting a behavioral response to the morphology of large sand dunes under an arid climate.

HCG036-P04

Room:Convention Hall

Time:May 24 14:00-16:30

Sediment wave developments observed in the Aoshima Formation, Miyazaki Group: based on the interpretation of cyclic step

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Sediment waves, which are a form of depositional topography observed in deep-sea environments, are characterized by orderly reliefs of very long wavelengths with low amplitudes (Migeon et al., 2004). Coarse-grained deposits (sediment-gravity flow deposits with grain sizes > 0.25 mm) and rip-up mud clasts found in sediment wave deposits in deep-sea environments are generally observed on the upslope of the waves; however, they are also deposited on the downslope of the waves through hydraulic jumps (Migeon et al., 2001; Nakajima and Satoh, 2001). Cyclic steps, which have been suggested as one of the causes for the formation of sediment waves, experience such hydraulic jumps (Fildani et al., 2006). Evidence found in outcrops, the fact whether sediment wave deposits are formed in cyclic steps, detailed mapping of grain sizes, and distribution of rip-up mud clasts, essential elements for the determination of hydraulic jumps, are required, in addition to descriptions of sedimentary structures and bed thickness. In this study, we obtained a detailed map of grain sizes and rip-up mud clasts in sediment wave deposits in turbidite successions of the Aoshima Formation, Miyazaki Group, suggested by Takii et al.(2010). We discuss the formation of a sediment wave as the cyclic steps experienced hydraulic jumps during the forming processes.

The Aoshima Formation is the uppermost part of the Miyazaki Group filling the Neogene forearc basins (Shuto, 1952). We studied suggested sediment waves in the outcrops of the Shirahama coast, Miyazaki City. The results revealed that coarse-grained deposits and rip-up mud clasts are distributed at irregular intervals in the sediment-gravity flow deposits, suggesting a migration of the deposits and clasts in the upstream direction. The sediment-gravity flow deposits including coarse-grained deposits and rip-up mud clasts, which are thought to be deposits that experienced hydraulic jumps, are mainly composed of graded beds. The sediment-gravity flow deposits with such graded beds occur alternately with massive beds in the paleocurrent direction. These alternate occurrences in the sediment-gravity flow deposits suggest that cyclic step formation with some intervals of hydraulic jumps.

Keywords: sediment waves, cyclic steps, sediment-gravity flow deposits, hydraulic jumps

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HCG036-P05

Room:Convention Hall

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Characteristic of flood deposits in the Chikugo-gawa River, Kyusyu, West Japan

Takanobu Kamataki^{1*}, Tomio INAZAKI², Takashi Arai³

¹OYO Corporation, ²Public Works Research Institute, ³Daiwa Geological Laboratory

We studied a characteristic future of recent flood deposits in the Chikugo-gawa River, Kyusyu, west Japan. This study was based on 8 core samples, taken from main stream of the Chikugo-gawa River. These cores were analyzed of sedimentary structure, grain size distribution, and magnetic susceptibility.

In this presentation, we would like to discuss and consider the characteristic of flood deposits.

Keywords: flood deposits, sedimentary structure, Chikugo-gawa River

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HCG036-P06

Room:Convention Hall

Time:May 24 14:00-16:30

Fundamental Study on Development of Man-made Beachrock: Mechanical tests and elemental analyses of Beachrocks in Okinawa

Takashi Danjo^{1*}, Satoru Kawasaki¹

¹Hokkaido University

Beachrock is a coastal deposit that is cemented by calcium carbonate and/or silica in the tidal zone of a sandy beach in the tropical zone and the subtropical zone. Considering an application of man-made beachrock to submerged-looking islands as a preservation material, we had performed a literature survey in order to understand essential information of beachrocks. For the study of mechanical properties and mineral contents of beachrock, we performed in situ tests and laboratory tests for beachrocks of Okinawa Island. As a result, it was shown that unconfined compression strength of the beachrocks increased with time and presented about 43.75 MPa after several thousand years. It was also cleared that the strength of the beachrocks was larger than or equal to that of sea water proof concrete using cements of blast-furnace, silica, fly ash and others. Furthermore, it was found that the beachrocks investigated in this paper consisted mainly of Ca and C.

Keywords: beachrock, Okinawa Island, mechanical property, element content

HCG036-P07

Room:Convention Hall

Time:May 24 14:00-16:30

Internal Stress Fields of a Large-Scale Submarine Debris Flow

Hajime Naruse^{1*}, Makoto Otsubo²

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Detailed analysis of a submarine debris-flow deposit exposed as a nearly 1.6 km continuous outcrop reveals existence of a compressional stress field during transportation and deposition. Deposit of gravelly mudstone, containing large deformed sedimentary blocks (long axis up to 100 m), occurs in the Upper Cretaceous (Maastrichtian) to Paleocene Akkeshi Formation, Hokkaido Island, northern Japan. This mass-transport exposure exhibits three facies, based on size and spatial arrangement of accumulated blocks. Facies A consists of relatively small blocks (long axes approximately 1 to 10 m), supported by a gravelly mudstone matrix. Facies B consists of clast-supported moderate blocks (long axes ~30 m). Generally, blocks in Facies B are deformed significantly. Facies C mainly comprises large blocks with long axes up to 100 m. Facies A and B alternate downcurrent, while Facies C occurs only at the more distal end of the exposure. Usually, long axes of blocks are oriented parallel to the bedding surface, suggesting a laminar state of flow. Application of the multiple inverse method to meso-scale faults observed in the blocks reveals possible internal paleostress fields that existed before deposition. This analysis suggested two different stress fields: (1) a uni-axial compressional stress field, where maximum principal compression axis is normal to bedding surface, and (2) a tri-axial compressional stress field, where orientation of maximum principal compression axis is parallel to paleocurrent direction. Numerical simulation of a submarine debris flow using the bi-linear rheology model indicates that this mass-transport deposit experienced the first stress field when it moved downslope, thereby expanding its surface area. It then experienced the second stress field as it decelerated, because of compression parallel to paleocurrent direction. Although the second stress field caused by deceleration of the flow occurs in any conditions, the first stress field that is related to the initial flow expansion occurs depending on the initial flow geometry and yield strength of the flow matrix. Thus, the result of this study implies that (1) a horizontal compression paleo-stress field can be an indicator of the paleocurrent direction of the debris-flow, which is generally difficult to be reconstructed from the outcrop data. In addition, it is also suggested that existence of a vertical compression paleo-stress field can be a clue for the initial conditions of the submarine landslide.

Keywords: submarine debris flow, paleostress analysis, paleocurrent analysis, gravelly mudstone, submarine landslide