Occurrence of Huge Mountain Collapse and its Sediments Developing in Niigata - Nagano Prefecture border, Central Japan ; Pleistocene Epoch Events

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1. PASCO CORPORATION

1.Introduction
I review the huge collapse in non-volcano regions similar to "mountain collapse - rockslide avalanche occurrence" occurred in many volcanoes. The survey area is the northeastern part of the Sekita Mountains located in the Niigata - Nagano prefecture border, and the northern side of the ridgeline has a maximum height of 400 m and a steep cliff extending over about 6 km extension. The huge collapse formed the small undulation flat surface such as the Shoubu Plateau, the upper stream area of the Shibumi River, the Daigonji Plateau, and so on. At present, traces of huge collapse are confirmed in 5 places. According to Takeuchi et al.(2000), the Uonuma Formation of the late Pliocene to Late Pleistocene is distributed around these areas.
2.Huge collapsed terrain
In this paper, I call the huge collapse that formed the Shoubu Plateau and so on as Nonomi collapse, call the collapse that formed a small undulation flat surface in the upper stream area of the Shibumi River as Tensui collapse, and call the huge collapse that formed the Daigonji Plateau as Daigonji collapse, and discuss these collapse cases. The Nonomi collapse has a sliding cliff of 150 m in height and a sliding width of 950 m in width as a cliff top. The horizontal flow distance of sediment is estimated to be 2,700 m and the layer thickness is estimated to be 50 m at the maximum and 15 to 20 m on average. The Tensui collapse has a sliding cliff with a maximum relative height of 400 m and a sliding width reaching 3,000 m. The horizontal flow distance of the sediment is estimated to be 4,500 m, the layer thickness is estimated to be 15 to 30 m on average, and 3 sites of hummocky mass can be confirmed. The Daigonji collapse is estimated as the top of the cliff in the vicinity of Tensuiyama Mountain. The horizontal flow distance of the sediment is estimated to be 3,300 m and the layer thickness is estimated to be 10 to 35 m on average.
3.Properties and composition of collapsed deposits
Collapsed sediments consist of sedimentary layer(sis) consisting of siltstones and sedimentary layer(tfb) mainly composed of andesitic volcanic rocks. Both strata are consolidated to such a degree that they can’ t easily penetrate with a hammer. The sedimentary layer composed of siltstone is densely packed in angular clast with a diameter of about several cm, and it may include andesite angular clast. Features of the sedimentary layer composed mainly of andesitic volcanic rocks are 1)clast-supported ~ matrix-supported sediment containing a large number of angular to subangular clast (ϕ - 3 m, mostly ϕ 10 - 50 cm) of andesite, 2)sedimentary structure with water during deposition can’ t be seen, 3)besides andesite, siltstone, sandstone, tuff, etc. are present in the clast, and it contains Kusare clast, 4)matrix part is tuffaceous sand mixed silty and fresh part is blueish gray to blue-greenish gray. The sedimentary layer due to Nonomi and Tensui collapse was formed from basement strata, tfb-1(maximum layer thickness 20 m), sis-1(same 5 m), sis-2(15 m), tfb-2(10 m), tfb-3(20 m), topsoil. Paleosol ·organic matter of several cm thickness is sandwiched between sis-1 - sis-2 and sis-2 - tfb-2. On the other hand, the sedimentary layer due to the Daigonji collapse is layered from the base to the upper tfb (maximum layer thickness 20 m), sis(15 m), tfb(10 m), topsoil.
4.Origin of collapse and collapse sediment
Sediments generated by the huge collapse originate from the Uonuma Formation. With reference to

Takeuchi et al. (2000), the collapsed strata are mainly of the Uonuma Formation, andesite tuff breccia, volcanic tuff and marine silt sand phase. Stratigraphically, the former is higher and the latter is lower. This huge collapse shows a cycle in which the lower stratum is repeatedly collapsed while the gap is sandwiched by the extent of formation of old soil after stratigraphically upper strata collapse and then the upper strata collapse again. A relatively large time gap occurred at least twice.

5.Discussion

The huge collapse is presumed to have at least 5 events from the sedimentary layer distribution. However, from the Lidar data, the occurrence of more events is estimated, and correspondence with the sedimentary layer, the identification of the time and the contrast of the collapsed sedimentary layer are future tasks.

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Keywords: huge collapse, rockslide avalanche, Pleistocene Epoch, Uomuma Group, Sekita Mountains

Three-dimensional analysis with high-frequency ground penetrating radar of tsunami experiment deposits

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A tsunami experiment was conducted in a wave flume (205m in length, 60cm in width, 95cm in depth) in CRIEPI (March 1, 2016). GPR (Ground Penetrating Radar) scanning with a high frequency antenna (1.6GHz) was performed for the experiment deposits. The used material was sand (median, 0.2mm) and dune (20cm in height) was formed in the center of flume. A tsunami (wave height, 80cm) went over the dune, and run up to the landside, and deposited sand layer, 1-3cm in thickness. The GPR measurement was carried out for 10 m long around the dune. GPR profiles show three-dimensional low basin-shaped reflection around the dune, and parallel reflection consisting of two levels that was a gently convex upward in the landside. This result matches the CT result (Yoshii et al., 2016). The trench of the deposits confirmed that the low basin-shaped reflection was caused by the hydraulic jump at dune. As for the tsunami deposit, it was revealed that the boundary surfaces between different two layers (the lower coarse-grained sand layer and the upper fine-grained sand layer) became the gently convex upward reflection.

Yoshii T., M. Matsuyama and S. Tanaka (2016) Sedimentary characteristics of tsunami deposits made in wave flume. JpGU2016. MIS11-P18.

Keywords: tsunami deposits, GPR, experiment

Distribution pattern of surface sediments around Okinoerabu-jima and Tokuno-shima Islands

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The distribution pattern of surface sediment around Okinoerabu-jima and Tokuno-shima was compiled based on 155 surface sediment samples and sub-bottom profiler (SBP) records. Surface sediments around islands above water depth 600 m show gravel and very coarser sand and are characterized by high contents of calcium carbonate deposition mainly originated from coral, shells and briozoans. These results indicate that depositional environment in this area is affected by strong hydrodynamics effects. Spatial variation in grain size of surface sediments west off the Okinoerabu-jima and Tokuno-shima (eastern edge of Okinawa Trough) shows to become a finer toward increasing in water depth, and silt sediments including planktonic foraminifera are deposited in the Yoron and Okinoerabu basins below the water depth of 800 m. Stratified reflectors with the penetration depth of 60-80 m in the SBP profile are observed in these basins. These results indicate that hydrodynamics effects to sedimentary process decrease toward the increasing water depth and hemipelagic sediments are deposited in the basin. On the other hand, sand sediments are distributed at the seafloor to water depth of 1200 m in the eastern area of the Okinoerabu-jima and Tokuno-shima. Discontinuous stratified reflectors of the SBP profile are widely observed in this area. Compering with grain size and SBP records in the western area of the Okinoerabu-jima and Tokuno-shima, sedimentary process in the eastern area of these islands is affected by strongly hydrodynamics effect caused by open topographic.

Keywords: sediment, grain size, Okinoerabu-jima, Tokuno-shima

Environmental history of Lake Kasumigaura during the last 600 years

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Environmental history of Lake Kasumigaura during the last 500 years is clarified based on the result of grain size analysis and total organic carbon, total nitrogen and total sulfur contents of cored sediment taken at the central part of Lake Kasumigaura. Age controls used are Asama-A tephra of 1783 AD, Fuji-Hoei tephra of AD 1707 and carbon-14 date of Corbicula japonica fossils. Profiles of grain size and element contents versus age show that the closed lake condition developed gradually until the eruption of Mt. Fuji in 1707 and further developed after the eruption of Mt. Asama in 1783. Former studies showed that the closing of the lake condition developed gradually owing to the wide interval of sampling, however, the result of this study shows that the change of lake environment was very short period. The reason for abrupt environmental change was caused by the rapid burial of the inlet of lake with volcanic materials which flew from river Tone. This caused decrease in changing waters of the lake and that from the Pacific Ocean.

Keywords: Lake Kasumigaura, Environmental history, sediment

Evaluation of ichnodiversity by image-resampling method to correct outcrop exposure bias

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This study proposes a new method to evaluate the diversity of ichnofossils from the outcrop records. Ichnofossils are records of responses of benthic animals to marine environmental conditions. Therefore, detailed analyses of ichnoassemblages provide information of the paleoenvironmental conditions on ancient seafloor. Activities of benthic animals affect superficial to subsurface sediment on seafloor. For instance, burrowing or grazing by infauna may rework sediment and destroy sedimentary structures. These behaviors may raise pore water oxygenation level, and may result in accelerated decomposition of the organic matter in sediment (Aller, 1994). Thus, it is important to evaluate ichnoassemblage in quantitative way from various aspects (e.g. diversity, abundance, disparity, and bioturbation intensity) to reveal the paleoenvironmental conditions from geologic records. Particularly, ichnodiversity (defined here as number of ichnogenera in an ichnoassemblage) is regarded as an important parameter that characterizes sedimentary environments (e.g. Cummnings and Hodgson, 2011). However, numbers of ichnogenera observed in outcrops reflect not only actual diversity in activities of benthic animals but also exposed area of observed outcrops. Even though there are several established methods for correcting such sample size biases in studies of paleobiodiversity, such as rarefaction (Sanders, 1968) or shareholder quorum subsampling (SQS; Alroy, 2010), these methods cannot be applied to analyses of ichnodiversity because number of individuals of ichnofossils is difficult to identify due to their morphological characteristics. For instance, an individual specimen of planar-formed regular network graphoglyptids that may be preserved in fragments cannot be defined in observation on outcrops.

To this end, this study proposes a new method to evaluate the ichnodiversity independent of exposed area of outcrops by using of image-resampling technique with application of the SQS method. The procedures of our method are following. First, the line-of-interest for data resampling is randomly set in the acquired outcrop image. The number of ichnogenera on the line is then counted. As the length of the line-of-interest increases, the number of counted ichnogenera increases. Repetition of this resampling process derives the relationship between the observed length and number of ichnogenera, which can be approximated by the non-linear function fitted to the resampled data. The obtained curve can be regarded as the equivalent of “rarefaction curves” of the biodiversity. Next, the ichnodiversity (the expected number of ichnogenera) of the examined outcrop image is calculated at a given value of the “coverage” of the actual diversity, which is estimated from the slopes of the tangential lines of “rarefaction curves” (Chao and Jost, 2012). Consequently, fluctuation of the ichnodiversity in the outcrop image data at any given “coverage” is obtained independent of differences in the exposed area of outcrops. This method was applied to artificial data of ichnoassemblages to verify the methodology particularly on effects of distribution patterns of ichnofossils on bedding planes. Ten kinds of artificial ichnofossil images were allocated on the virtual bedding planes to generate artificial outcrop images showing ichnoassemblages. In these series of experiments, two types of spatial distribution pattern of ichnofossils were examined: uniform and patchy distributions. Our method indicated that the distribution patterns did not affect ichnodiversity at sufficiently high “coverage.”

This method was also applied to the field data of deposits of the submarine channel-levee complex in the Izaki olistolith of the Nichinan Group distributed on the southeastern part of Kyushu, southwestern Japan (Sakai, 1987). Our method revealed that the ichnodiversity of the successions in the Izaki olistolith is relatively high in channel deposits and is low in levee deposits.

Keywords: Ichnofossil, Ichnodiversity, Outcrop exposure bias, submarine channel-levee deposits

The comparison of heavy mineral assemblage and chemical composition of detrital garnets between Bengal Fan and Himalayan foreland basin sediments

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The submarine Bengal Fan is the largest submarine fan system on Earth. The changes in the mineral assemblages of fan sediments record the uplift history of the Himalayan orogenic system.
IODP Expedition 354 drilled seven sites in an E–W transect along the 8˚N latitude in the Bengal Fan (France-Lanord et al., 2015). The deepest site U1451 A and B recovered a complete sequence of fan deposits. The sediments drilled at this site consisted of mica and quartz-rich sand, silt, and clay, with the exception of the lower Oligocene-Eocene section. In this study, we examined the chemistry of detrital garnets in the sediments in Bengal Fan and Siwalik Group in Nepal in order to compare both provenance characteristics. The garnet compositions plotted are shown on the Py-Sp+Alm-Gro-And triangular diagram with discriminant fields by Mange and Morton (2007). The data of mineral assemblage in the Siwalik Group is after Yoshida et al. (2016).
It is already reported that the heavy mineral assemblage of the Late Oligocene silt-sands mainly consists of tourmaline and rutile assemblage with rare garnet and amphibole by Yoshida et al. (2016). At the early part of the Middle Miocene sequence, amphibole and garnets increase rapidly, and there are frequent occurrences of aluminosilicate and staurolite. In the Middle Miocene sediments, the assemblage of heavy minerals becomes diverse, and metamorphic minerals, such as staurolite, chloritoid, aluminosilicate, amphibole, and garnet, are normally included in the sediments. The detrital garnets show the derivation from crystalline schist and amphibolite facies metamorphic rocks in the Early Miocene period and granulite facies metamorphic rocks in the Middle Miocene period.
In the lower Siwalik Group, foreland basin deposits, the mineral assemblage is characterized by the predominance of zircon and tourmaline. The heavy mineral assemblage was changed in the middle part of the lower Siwalik Group. The sediments include a large amount of blue-green amphibole and aluminosilicates (kyanite and sillimanite) with staurolite and chloritoid. In the end of Early Miocene, the detrital garnets were shed mainly from amphibolite facies metamorphic rocks. The detrital garnets were derived from granulate and amphibolite facies metamorphic rocks in the Middle Miocene time. These changes seem to have been occurred around 13-10 Ma in western Nepal and 9-7 Ma in central Nepal (Yoshida et al., 2016).
These measurements of heavy minerals demonstrate wide exposure and sediment production from a metamorphic terrane in the Himalayas during the Middle Miocene period, though these high-grade metamorphic minerals are occasionally included in Early Miocene sands. Also the above mentioned metamorphic mineral grains of Early Miocene and Late Oligocene sands may record exposure history of a metamorphic terrane, consists of amphibolite facies, prior to the period of high sediment production during the Middle Miocene. The chemistry of detrital garnet, records the gradual change of source terranes, from low-grade metamorphic facies and amphibolite facies to high-grade metamorphic facies. This change is similar to the provenance transition recorded in foreland basin deposits.

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Keywords: Himalaya, sediment composition

Lithological properties on diagenesis process of Miocene carbonate rocks in northeast Java basin, Indonesia

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Currently Northeast Java Basin contains the sixth largest oil reserve in Indonesia, but the complexity and heterogeneity of carbonate reservoir increasing the exploration risk. Sedimentology and diagenesis process are the most fundamental aspects for appropriate exploration. Accurate knowledge of these parameters for hydrocarbon reservoir is required for increasing performance of the oil and gas field. Thus, sedimentology as well as diagenesis aspect must be studied as detail as possible. This should be done along with microfacies analyses and stable isotope analyses.
The Miocene carbonate rocks of 283m thick were deposited in a high energy shallow marine settings in a rifting basin. The carbonate succession can be divided into 3 main units from base to top: fine grain limestone, dolostone, and coarse grain limestone. Fine grain limestone, wackestone and mudstone, was interpreted as fore-mound carbonate likely derived from pre-existing limestone, characterized by the abundances of intraclasts. Dolostone unit was a diagenetic product from marine dolomitization process. The planar structure with polymodal fabric of dolostone suggest that dolomitization process was worked on single nucleation from homogenous parental rocks under uniform growth at low temperature (Sibley and Greg, 1987). While coarse grain limestone, packestone and grainstone, is interpreted as terrigenous carbonate in which its fossil components show different responses to fluctuation of silisiclastic influx. Negative values both of $\delta^{13}C$ and $\delta^{18}O$ on limestone and dolostone unit suggest a marine diagenesis process followed by an intensive meteoric diagenesis that was likely related with tectonic uplift activity. In detail, the dolostone unit showed higher $\delta^{18}O$ value than limestone unit, most likely associated with different fractionation factors between dolomite and calcite. Between two limestone units also showed different values both $\delta^{13}C$ and $\delta^{18}O$. The coarse grain limestone unit showed lower both $\delta^{13}C$ and $\delta^{18}O$ values than fine grain limestone. This suggests that meteoric diagenesis works very effectively on coarse-grained and permeable limestone in which meteoric water easily go through into the rocks, then change its constituents.

Keywords: Limestone, Dolostone, Miocene, Indonesia

