Effects of flash floods on stream sedimentation of an urbanized order-1 River Basin in the humid tropical environment

Udosen, C.[1]

[1] Geography Department, University of Uyo, Nigeria - charlesudosen@gmail.com

A statistical analysis of rainfall records (1977-2013) in Uyo (Nigeria) shows that the rainfall is mainly convectional, often high intensity rainstorms accounting for more than 70 percent of the total annual rainfall. Annual rainfall is highly variable ranging from 1599.5mm in 1983 to 3883.9mm in 2012, c.v. was 63.8% and mean of 2540mm. Both 3-yr and 5-yr cycles indicate a rising trend in total annual in recent years. The study also involved both morphometric analysis and video recording of a 141mm rain event draining into the 1.6km stream (basin relief of 79m & channel slope of $3^{o)}$. Results on stream sedimentation indicated very high rates and heavily degraded stream water viz; P^{H} 5.23; Temperature 26.7^{o}C; BOD 2.5mg/l; DO 6.8mg/l; colour 21.4 Hazen; TSS 13.65mg/l; TDS 22.7 mg/l; conductivity 36.4(Uscm^{-1}) and corresponding values of 1.19, 10.0, 0.44 and 0.23 mg/l for nitrate, chloride, sulphate and phosphate respectively. These values varied significantly from the lower values recorded before the rainstorms. The runoff of 78.9m^{3}s^{-1} shows that pollution in the stream is attributed to episodic events as >70% of total rainfall is due to rainstorms > 80mm. The study indicates that the natural hydrologic regime of the urbanized stream is altered as bioaccumulation of inorganic substances from the storm water and farmlands has affected aquatic life.

An improved resin-embedding method for imaging microstructures of fine-grained marine sediment using microfocus X-ray CT and SEM

Uramoto, G.-I.[1], Morono, Y.[1], Uematsu, K.[2], Inagaki, F.[1]

[1] Kochi Institute for Core Sample Research, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Monobe B200, Nankoku, Kochi 783-8502, Japan - uramotog@jamstec.go.jp
[2] Marine Works Japan Ltd., 3-54-1 Oppamahigashi, Yokosuka 237-0063, Japan

Marine sediments are composed of various mineral species, and are characterized by micro-scale grain fabric. The arrangements and interactions of component particles place critical constraints on the physical, chemical, and biological processes that occur in subseafloor environments. However, the observation of nearly intact microstructures is difficult, especially in soft, muddy sediments, because of their high water content and the presence of organic molecules. In this study, a modified version of the resin-embedding method generally used for biological samples was applied to continental margin sediments in the Canterbury Basin and pelagic sediments in the South Pacific Gyre collected during the integrated ocean drilling program (IODP). The new method was compared with the conventional t-butyl alcohol freeze-drying method using microfocus X-ray computed tomography (mXCT) and scanning electron microscopy (SEM). The mXCT and SEM results showed that all t-butyl alcohol freeze-dried sediment samples contained microstructural disturbances (e.g., cracks). In contrast, no cracks were observed in the samples prepared using the new resin-embedding method, and the microstructural arrangement of the sediment particles were clearly visible. In addition, the porosity visible from SEM images of the resin-embedded samples was similar to that measured using the moisture and density method, providing additional evidence that the microstructures of the resin-embedded samples were well preserved. The resin-embedding method allowed high-resolution two-dimensional observation of sediment microstructures and we could observe clay microaggregates throughout the continental margin to pelagic sediments. In particular, abundant microaggregates were present in organic-poor oxic pelagic clay. Energy dispersive X-ray spectrometry analysis revealed microaggregates in pelagic clay contained manganese and iron, and shape of the microaggregates are similar to manganese micronodules. This modified biological resin-embedding method is suitable for the detailed observation and examination of fine-grained marine sediment microstructures.

Decoupling of sediment routing in the Nankai Forearc: Evidence from provenance analysis of turbiditic sands

Usman, M.O.[1], Masago, H.[2], Winkler, W.[1], Strasser, M.[1]

[1] Department of Earth Sciences, Geological Institute, ETH Zurich, Sonneggstrasse 5, 8092 Zurich, Switzerland - muhammed.usman@erdw.ethz.ch
[2] Center for Deep Earth Exploration, Japan Agency for Marine-Earth Science and Technology, 3173-25 Showa-machi, Kanzawa-ku, Yokohama, Kanagawa 236-0001, Japan

Coring during Integrated Ocean Drilling Program (IODP) Expeditions 315, 316, and 333 recovered turbiditic sands from the forearc Kumano Basin (Site C0002), a Quaternary slope basin (Site C0018), and uplifted trench wedge (Site C0006) along the Kumano Transect of the Nankai Trough accretionary wedge offshore of southwest Japan. The compositions of the submarine turbiditic sands here are investigated in terms of bulk and heavy mineral modal compositions to identify their provenance and dispersal mechanisms, as they may reflect changes in regional tectonics during the past ca. 1.5 Myrs. The results show a marked change in the detrital signature and heavy mineral composition in the forearc and slope basin facies around 1 Ma. This sudden change is interpreted to reflect a major change in the sand provenance, rather than heavy mineral dissolution and/or diagenetic effects, in response to changing tectonics and sedimentation patterns. In the trench-slope basin, the sands older than 1 Ma were probably eroded from the exposed Cretaceous-Tertiary accretionary complex of the Shimanto Belt and transported via the former course of the Tenryu submarine canyon system, which today enters the Nankai Trough northeast of the study area. In contrast, the high abundance of volcanic lithics and volcanic heavy mineral suites of the sands younger than 1 Ma points to a strong volcanic component of sediment derived from the Izu-Honshu collision zones and probably funnelled to this site through the Suruga Canyon. However, sands in the forearc basin show persistent presence of blue sodic amphiboles across the 1 Ma boundary, indicating continuous flux of sediments from the Kumano/Kinokawa River. This implies that the sands in the older turbidites were transported by transverse flow down the slope. The slope basin facies then switched to reflect longitudinal flow around 1 Ma, when the turbiditic sand tapped a volcanic provenance in the Izu-Honshu collision zone, whilst the sediments transported transversely became confined in the Kumano Basin. Therefore, the change in the depositional systems around 1 Ma is a manifestation of the decoupling of the sediment routing pattern from transverse to long-distance axial flow in response to forearc high uplift along the megasplay fault.

Acknowledgements: We thanks the following organisations for their support: International Ocean Discovery Program (IODP), Swiss National Science Foundation (SNF), and “Sand for Students” outreach program under the supervision of JAMSTEC,

Radiocarbon dating of mass sediment remobilization/depositional sequences in the hadal zone: A robust chronological tool for deep-water event stratigraphy?

Usman, M.O.[1], Fink, H.[2], Kölling, M.[2], Strasser, M.[1], Eglinton, T.I.[1]

[1] Geological Institute, ETHZ, Zurich, Switzerland - muhammed.usman@erdw.ethz.ch
[2] MARUM-Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany

The 2011 earthquake off the Pacific Coast of Tohoku induced large-scale sea-floor displacements, triggering submarine landslides and gravity flows in the Japan Trench. The ~7.5km deep Japan Trench, a remarkable depression near the epicenter, serves as a depocenter for this, as well as prior earthquake-triggered mass flows originating from the landward slope. It therefore represents an ideal site for studying past earthquake event deposits and for examining sedimentological and biogeochemical implications of rapid sediment transfer from the continental margin to the hadal zone of the ocean. Coring during the RV Sonne SO219A cruise recovered sediment cores from the east of the 2011 Earthquake epicenter in a 60 km north-south transect along the Japan Trench floor axis. Stratigraphic analysis reveals several turbidite sequences ranging in thickness from a few cm to over a metre, mainly showing a coarse sand layer on an erosive base and a gradually fining upward to hemipelagic diatomaceous mud. Below the 2011 event deposit, at least three thick (several tens cm to a few m thick) turbidites were recognized. The third turbidite unit is characterized by calcareous nannofossil-bearing turbidite muds, suggesting translocation of sediment originating from the upper-mid slope above the carbonate compensation depth (CCD). An intercalated volcanic ash between the second and third turbidite units provides a tephrochronological tie (Towada-a ash A.D. 915), suggesting the calcareous nannofossil-bearing unit might correlative to the Jogan tsunami deposits on the Sendai plain (A.D. 869). However, the lack of robust chronology (e.g. conventional radiocarbon dating of calcareous micro-fossil is not feasible in sediment deposited far below the CCD) hampers conclusive event stratigraphy interpretations. Here, we present preliminary bulk (% total organic carbon, TOC, $\delta^{13}C_{TOC}$, $^{14}C_{TOC}$), and molecular-level (including compound-specific radiocarbon dating of short-chain fatty acids ($<C_{20}$) measurements in an attempt to constrain the provenance and age of specific diatomaceous mud units. Our initial results suggest that compound-specific radiocarbon analysis is a promising tool in dating and developing an age models for hadal sediments.

Acknowledgements: We thanks the scientific party of the RV Sonne S0219A cruise as well as the Swiss National Science Foundation grants PP00P2-133481 and 200021_140850/2 to Michael Strasser and Timothy Eglinton, respectively.

Fluvial sand grain producing process revealed from changes in lithology and roundness of gravel and sand in the watershed of Watarase River, central Japan

Utsugawa, T.[1], Shirai, M.[1]

[1] Tokyo Metropolitan Univ., 1920397-Tokyo, Japan - utsugawa-takako@ed.tmu.ac.jp

Introduction

Downstream fining of fluvial clastic sediments has been generally attributed to two processes, "hydraulic sorting" and "sand grains production", the former is that finer grains are transported farther than coarser grains, while the latter implies crushing and abrasion of gravels. Investigation into "sand grains production" process is significant and adequate in Japanese rivers located on active tectonic zone characterized by steep gradient and short river length. For the previous studies on "sand grains production", pebble size fraction (64 to 4 mm in diameter) is generally used not only in the field surveys but also in the flume experiments. In order to elucidate how the two processes operate on downstream fining, we investigated change in several characteristics of gravels and sands, the latter could be product of "crashing and abrasion of gravels".

Methods

Sand grain producing process along the two tributaries of Watarase River, the major branch of the Tone River in the central Japan was investigated on the basis of field survey and measurement with digital microscope. We researched at the upstream site and downstream site in each tributary, where interval of sites is set as ca.10km.
In the field survey, we examined lithology, axis dimensions and roundness following the "Krumbein chart" of cobble – pebble (128 to 8 mm in diameter) which were obtained from the point bars. Approximately 130 gravels were measured at each sampling site.
Granule – coarse-grain sand (4 to 0.5 mm in diameter) were sieved from fine clastic grains underlying the measured gravels were sampled, and then the lithology and the roundness of the grains were examined with 1 phi scale intervals using digital microscope.

Results

Comparison between upstream and downstream sites along the tributaries showed changes in lithological composition in cobble – pebble, granule and very coarse sand fractions. Ratio of harder chert and softer shale, ch/sh, increase to downstream in spite of covering of bank protection wall and partially exposure of shale rocks. So it is difficult to explain only with "hydraulic sorting" of clastic grains. It implies that crushing and abrasion of gravel – very coarse sand fractions, therefore, "sand grains production" occur at the studied area. It is consistent with the decrease in roundness of each grain size fractions which suggests newly produced grains.
Whereas, coarse sand fraction (1 to 0.5 mm) shows remarkable features that (i) change in ch/sh ratio along the tributaries were not recognized and (ii) both chert and shale grains become rounded in downstream direction. These facts suggest that abrasion of the grains occur dominantly than crushing in coarse sand fraction and "sand grain production" may not be efficient to grains smaller than coarse sand.

Conclusions

We qualitatively indicated that crushing and/or abrasion of gravels produce the finer grains. It is important to research the distribution of coarse sand and finer grains in bed material along the river, in order to reveal the transition from domination of "producing process" to "sorting process" and to understand erosion-transport processes of clastic sediments. As a next step, we will attempt evaluating size and roundness of grains using quantitative image analysis for efficient data collection.