

## Chemical weathering rates in granitic mountains in Japan: Estimation from cosmogenic radionuclides and geochemical mass balance method

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Recently denudation rates or exposure ages in mountains underlain by granite were estimated from cosmogenic radionuclides. Many studies also combined this method with geochemical mass balance approaches and estimated chemical weathering rates in granitic mountains, assuming steady state conditions. We applied the modified methods to three mountainous areas (North Alps, Rokko Mountains, and Abukuma Highland) in Japan with various tectonic and climatic conditions. The three surveyed areas include small target basins; 9 basins in North Alps, 4 basins in Rokko Mountains, 2 basins in Abukuma Highland. All these basins are underlain by biotite granite, and basin-wide denudation rates were estimated from cosmogenic <sup>10</sup>Be in stream sediment. We collected stream sediment as weathered material in these basins and several fresh bedrock samples in each study area. Stream sediment is sieved into three fractions; F: 0.063 - 0.25 mm, M: 0.25 - 2.0 mm, C: 2.0 - 9.5 mm. We measured chemical compositions of fresh bedrock and the fractions of stream sediment in each basin with X-ray fluorescence analysis (Phillips PW2400, Saitama Univ.), and calculated chemical depletion fraction (CDF), which is defined as the ratio of chemical weathering rate to total denudation rate. Both grain-size distribution of soil and chemical composition in the three fractions of stream sediment were used for calculating mean concentration of immobile elements in weathering materials. Titanium was treated as an immobile element for calculation of CDF. Chemical weathering rates generally increase with increasing basin-wide denudation rates, although they are more diverse for basins with high denudation rates (> 1000 mm/kyr). The values of CDF ranged from 0.02 to 0.40 for North Alps, 0.12 - 0.33 for Rokko Mountains, and 0.43-0.67 for Abukuma Highland. Contribution of chemical weathering to total denudation is relatively high in Abukuma Highland where landscape is gentle and denudation rates are low (< 100 mm/kyr). The causes for decrease in CDF in North Alps would be; (1) physical weathering processes due to cool climate in high elevation zones, and (2) erosion of saprolite after landsliding in basins with high denudation rates.

Keywords: chemical weathering, cosmogenic radionuclides, denudation rate

## High-resolution multibeam bathymetric mapping of barrier reef geomorphology of eastern Kume Island, the Ryukyus

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In contrast to the vast knowledge that has been accumulated regarding terrestrial landforms, few previous studies have dealt with shallow seafloor landforms. Since a broadband multibeam echosounder (Sonic 2022, R2 Sonic, LLC) and its accessory system were introduced to H. Kan's laboratory in 2010 using JSPS Grant-in-Aid for Scientific Research A, we have been conducting high-resolution multibeam bathymetric surveys around the Ryukyu Islands, southern Japan, and mapping the coral reef geomorphology with a horizontal grid size of 1-2 m.

Accurate descriptions of coral reef geomorphology improve our understanding of reef environments. Here, we introduce our mapping project, which covers of a total of 39 surveyed areas across five islands, and present an example illustrating the barrier reef and island shelf geomorphology of eastern Kume Island (1.8 x6.5 km bathymetric area, with a depth range of 0.4-161.3 m) combined with SCUBA and VTR observations.

The bathymetric area comprises two contrasting reef edge formations: a double reef in the western area, and a deep breakwater reef in the eastern area. The latter shows the high-energy window condition which is accompanied by spur and groove formation in the lagoon, formation of circular spits or bowl-shaped depressions behind the lagoon patch reefs, and traces of movement of coral boulders in the lagoon following typhoon storm surges. These observations enable us to understand and reconstruct the paleo-geomorphology and sedimentology in reefs associated with the Holocene high-energy window, and can also contribute to predictions of coastal environmental change associated with future sea level rise.

On the island shelf, we observed several reef terraces at depths between 80-95 m, and isolated patch reefs at 135 m depth. The discovery of these features may contribute to reconstructions of past sea level and reef growth in the northwestern Pacific.

Keywords: coral reef, multibeam ecosounder, lagoon, submarine terrace

## The significance of landslide dams on large Chinese rivers

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Landslides forming natural dams across rivers pose considerable hazards, particularly the risk of catastrophic flooding after dam failure. In China, documentary records of large earthquakes and river blocking landslides have enabled inventories to be compiled. However, the record is far from complete as the remote and rugged terrain shelters evidence both of recent landslide dams and of ancient landslides which occurred before documentary records. Geospatial technologies enable the detection of anomalies in fluvial geomorphological systems which may indicate the past influence of river blocking landslides. Field evidence of sediment deposited behind landslide dams, enables the location of palaeo-landslides to be inferred. Recent discovery of an ancient landslide which dammed the main stem of the Yangtze River, China (crest height 200 m; lake volume  $11.4 \pm 1.3 \text{ km}^3$ ) indicates that very large rivers have -and can be - impacted by persistent river-blocking landslides. As the magnitude of this landslide dam was much greater than examples in the historical record, it is argued that the potential for large earthquakes to generate enormous river-blocking landslides may be underappreciated as a mega-hazard.

Keywords: landslide dam, flood hazard, Yangtze River

## Solitary Step in Bedrock Rivers

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A solitary step is often observed to be formed in the mixed alluvium and bedrock rivers, which will be described later as "bedrock river" for simplification. Once a step is formed on the river bed, due to bedrock erosion, it is wondered whether the step is maintained and propagates in the upstream direction, or change its profile continuously. Compared with the bed of alluvial rivers which is easily eroded by flow, the mechanisms of bedrock erosion are more complicated, mainly including abrasion by bedload, plucking and macroabrasion. Based on this complexity, in this paper, we employ the Macro-Roughness Saltation Abrasion Alluviation model to analyze the evolution of a convex solitary step, featuring a subcritical region upstream and supercritical region downstream, in abrasion-dominated bedrock rivers. From the results of the analysis, we obtain that the convex solitary step cannot migrate in the direction of upstream with maintaining its profile. In addition, the erosion rate tends to be constant in the downstream reach, while the erosion rate increases drastically in the upstream reach. From a numerical simulation, it is found that the slope of the upstream region becomes larger and the curvature of the step downstream reach is maintained in relatively long time.

Keywords: Bedrock river, Solitary step

## Velocity and Sediment Concentration Distributions of Turbidity Currents

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Abstract. In this work, we present a mathematical model to describe the distribution of the velocity and the particle concentration of the turbidity currents. The turbidity current is described by the Navier-Stokes equations with the use of Boussinesq approximation to approximate the effect of sediment concentration on the flow, the diffusion/dispersion equation for the sediment transport, and  $k$ - $\epsilon$  turbulence model for the problem closure. The model is simplified by a roof-like configuration which allows a steady equilibrium state of the flow. The numerical solution of the distribution of the velocity, the sediment concentration, the turbulence energy, and the dissipation rate are obtained by the finite-difference numerical scheme. The study shows that the entrainment capacity of sediment due to turbulence and the dampening characteristic of turbulence is related with Richardson number and non-dimensional settling velocity. The model is capable of capturing the fundamental characteristics of the turbidity current which provides a vital base state for the analysis of morphodynamics generated by the turbidity current.

Keywords: turbidity current

## Comparison of different kind disasters and find of the similarity

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This study compared the damages and revival processes of Kawauchi village with Miyake Island. Kawauchi village was damaged by the 2011 Off the Pacific Coast of Tohoku earthquake. On the other hand, Miyake Island was damaged by volcanic eruption.

Kawauchi village is located in Fukushima prefecture, northeastern Japan. The population of 2010 was 2997 people. In this village, depopulation and aging advanced. The main industry was tertiary. Kawauchi village damaged by the 2011 Off the Pacific of Tohoku earthquake. The most serious damage was nuclear hazard. This village evacuated outside in 16, March, 2011. The refuge continued until January, 2012.

Miyake village is the Island of active volcano belonging to Tokyo city. The population of 1999 was 3872 people. The main industry before the volcanic eruption was sightseeing business. Miyake volcano erupted in June, 2000. A large quantity of volcanic gas and volcanic ash were spouted out. Landslide disasters were occurred frequently. All islanders of Miyake village evacuated outside of Miyake Island in September, 2000. The refuge continued until February, 2005. The service industry, the retail trade, the wholesale trade were decreased greatly. A village office moved under the influence of volcanic gas.

This study divided the damages of the two villages into two types. The first type affected the industry. Another one affected the community. We found same kind of damages and revival processes in different disaster.

Keywords: The Great East Japan Earthquake, Miyake Volcano, Disaster

## Study in Spatial Distribution of Sediment Strength in Omiya and north Musashino Uplands

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In order to investigate the  $N$ -values of underground sediments in Omiya and north Musashino uplands, isopleth maps were drawn using ArcGIS (ver 10. 3. 1, ESRI Japan Corporation). First, the summarized  $N$ -values data<sup>1)</sup> were referred and picked up the values of 3-m depth intervals. Then, by using the GIS software, each boring point was plotted and made isopleth maps of each 3-m interval. As a result, high  $N$ -value with the sediments composed by gravel is distributed in Musashino uplands, whereas low  $N$ -values less than 10 with mud and silt sediments between 24-33m depth in Omiya uplands. Sediment layers existing fossil shells are also pointed out in the original boring core data<sup>1)</sup> in Omiya uplands. The low  $N$ -value area is corresponded to the distributed area of Kioroshi formation, which deposited during Shimosueyoshi transgression. From these analyses of mapping data, it is concluded that it is important to choose it by not only surface landscapes but also considering the history of landscape development as well as geotechnical parameters such as  $N$ -values, when we decide the suitable low-cost construction site.

Keywords:  $N$ -value, Omiya upland, Musashino upland, Boring core sample, GIS

## Response to the uplift of a single channel in mountain rivers: Laboratory experiments

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In considering the development of mountain rivers, it is very important to know about the developmental process and the dynamics of downward erosion and lateral erosion, although these are partially understood so far. A previous experimental study for channel networks described that lateral migration of surface reliefs became dominant after the erosion rate reached the uplift rate on the whole. This report came from the observation through photograph of the entire basin, and studies in individual channel scales are very few so far. The purpose of the present study is to elucidate relative strength of downward and lateral erosion of bedrock river when experienced uplift, using model experiments. We targeted the observation of a single channel for measurements with high accuracy.

Experiments were performed two times under almost the same condition (Experiments A & B). The uplifts were realized by removing weirs of 1cm at the downstream end. Experiment A was carried out for 300 minutes, during which the uplifts were generated when the river bed seemed stable.

Meanwhile, Experiment B was continued for 260 minutes, in which the uplifts were actualized at the same timings as Experiment A regardless of the channel state.

The results, with few exceptions, showed that the elevation of the channel bed at any places continued to lower by downward erosion until a knick-point passed through, and thereafter lateral erosion occurred while downward erosion almost ceased.

Keywords: downward erosion, lateral erosion, profile



## Transport processes of huge riverbed boulder and landforms of the Miyanoura River in the Yaku Island, southern Japan

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There are huge boulders on the riverbeds of most rivers in the Yaku Island, southern Japan. The Miyanoura River is the most typical river and one of the largest rivers originated in the central part of the island. This study aims to discuss the production and transport processes of such huge riverbed boulders and relationships between the processes and landforms of the basin.

Most part of the Yaku Island, including the central part, is underlain by granitic rocks. The Miyanoura River, whose length is 17 kilometers, flows down in granitic area except the lowest section of 4 kilometers. Maximum diameter of the riverbed boulders is about 10 meters in the upper reaches. It decreases downstream to several tens centimeters as the channel slope decreases. Although uniform granite is underlain by this basin, maximum diameter of riverbed boulders correlates with channel slope. This indicates such boulders are transported by river being affected by sorting process. In the reaches of maximum boulder size being over 5 meters, relative height between ridges and valley bottoms is as large as 500m. There are many landslide scars in the tributary basins which join the Miyanoura River in these reaches. At the junctions these tributaries with steep channel slope develop alluvial cones on the valley floor. The deposits of the riverbed and the alluvial cones include huge boulders with several meters in diameter. Alluvial cone development across the Miyanoura River formed a dam. A dam break during a heavy rain event caused torrential floods and huge boulder transportation.

There is a continuous terrace along the middle reaches of the Miyanoura River. The terrace deposits consist of huge boulders of several meters in diameter. This terrace is not covered with the Koya pyroclastic flow deposits, which was erupted at 7,300 y.B.P. and which covered the valley side slopes around there. The cause of terrace is an important key to solve the cause of the huge riverbed boulders.

Keywords: huge riverbed boulder, sediment transport process, landform, Miyanoura River, Yaku Island, southern Japan