

日本列島の花崗岩山地における化学的風化速度：宇宙線生成核種と地球化学的物質収支法に基づく推定

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.

キーワード：化学的風化、宇宙線生成核種、剝速度

Keywords: chemical weathering, cosmogenic radionuclides, denudation rate

## 琉球列島久米島東部における堡礁地形の高解像度マルチビームマッピング

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.

キーワード：サンゴ礁、マルチビーム測深、礁湖、海底段丘

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 flow 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

## 異種災害の比較と類似性の抽出

## 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.

キーワード：東日本大震災、三宅火山、災害

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

## 大宮台地および武蔵野台地北部の地下地盤強度の空間分布

## 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.

キーワード：N値、大宮台地、武蔵野台地、ボーリングコア試料、地理情報システム

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

## 山岳河川における単一チャネルの隆起に対する応答：モデル実験

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

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山岳河川の発達を考える上で、下刻と側刻が発生するタイミングや順序について知ることは極めて重要であるが、これについては未だにわかっていない。隆起を受けた山岳河川網の挙動についてモデル実験を行った先行研究では、実験領域全体の時間あたりの侵食量が隆起量と釣り合ってから地形凹凸の側方移動が活発になる」と述べられているが、この報告は流域全体を真上から写真で観察したことによるもので、流路単位で調べたものではなく、この点について検証した例は非常に少ない。そこで本研究は、モデル実験を用いて、山岳地域におけるチャネルが隆起を受けた際の詳細な変動プロセスを明らかにすることを目的とし、単一チャネルに観察対象を絞り、高精度の測定を行った。

実験は2回（実験AとB）行い、1回の実験につき、隆起（ベースレベルからの上昇）は下流端に設けられた堰を1cm単位で2度下げることによって発生させた。1度目の実験は300分間行い、隆起は標高が安定したと思われるタイミングで発生させた。一方、2度目の実験は260分間行い、チャネルの状態に関係なく、1度目とほぼ同じタイミングで隆起を発生させた。

結果は一部を除いて、チャネルは、隆起の発生後に生じた遷急点が通過するまでは下刻により標高を低下させ続け、その後側刻が発生するというような挙動が観察された。流域全体の土砂収支に基づいた先行研究の観察事実と矛盾しない。ただし、流路内をより細かく局所的に見るとその限りではないこともわかった。例えば、実験Bの2回目の隆起の直後、下刻による標高の低下が収まるよりも早く側刻が発生したが、これは隆起を発生させる直前の縦断面の状態が不安定であったことに起因すると考えられる。また、実験Aおよび実験Bの1回目の隆起では、上流部はしばらくの間下刻が発生しなかったが、これは、流れの中に浸食ツールとして含まれる堆積物の量が少ないためと考えられる。

今後勾配や流量、砂の量比等を変え、複数回更に実験を重ねる必要があると思われる。

キーワード：下刻、側刻、縦断形

Keywords: downward erosion, lateral erosion, profile



## 屋久島，宮之浦川における巨大河床礫の運搬プロセスと地形

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.

キーワード：巨大河床礫、土砂移動プロセス、地形、宮之浦川、屋久島、南日本

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