

立体地形解析図を用いた福島第1原子力発電所事故による放射性セシウムの沈着状況の解析

An analysis of radiocesium distribution map due to accident of the Fukushima Dai-ichi nuclear power plant by using stere

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The Great East Japan Earthquake on March 11, 2011 generated a series of large tsunami waves that resulted serious damage to the Fukushima Daiichi nuclear power plant (NPP) and radioactive materials were discharged to the environment. After this accident, various types of measurements were performed to obtain the affected range and concentration of radioactive material depositions. In particular, the aerial radiation monitoring (here after ARM) has measured the ambient dose-rate and radiocesium deposition in large areas including those above the forest and the high mountain which people couldn't enter easily on foot or by vehicles, it is useful for grasping the distribution of contamination. It is thought that understanding the feature of the place where the radiocesium has deposited leads to solving the behavior in the atmosphere of the radiocesium discharged by the accident. In recent years, a stereoscopic slope mapping method has developed by the progress in analysis using digital elevation model (DEM) and being used widely. Since the geographical feature can be visualized to 3D-images by this technology, it is used for understanding the geographical features in various fields. In this research, we tried to analyze in visible clearly about the distribution of the radiocesium deposition by lapping the ARM results over the stereoscopic slope map.

The distribution map of the radiocesium deposition which was obtained by the ARM was lapped over the stereoscopic slope map of the whole of Japan by using 10m-mesh DEM data. The DEM data we used for analyzing the ARM data were employed 1.8-km, 3-km, and 5-km mesh data for the areas around the NPP, East Japan, and West Japan, respectively. The ARM data between each point of measurement were interpolated by using a GIS software. The interpolated data were outputted as a 25-m mesh data of the dose-rate map. Here we have lapped the data over the stereoscopic slope map

As a result, the high dose-rate areas more than 1.0 micro Sv/h spread from the NPP to 80 km northwestward, and it turned out southwest from there that the place more than 0.1 micro Sv/h. As for this distribution, radiocesium seems to pass along the low elevation areas between high mountains. On the other hand, the southern part of Iwate Prefecture and the southern part in Ibaraki Prefecture showed that the place more than 0.1 micro Sv/h is flat places comparatively.

It can become the assistance which solves the radiocesium diffusion and its migration by applying this technology to the detailed measurement result used the other monitoring, such as the radiation surveys by using unmanned helicopters.

キーワード: 立体斜度図, 航空機モニタリング, 福島第1原子力発電所事故, 放射性セシウム

Keywords: Stereoscopic slope map, Aerial monitoring, Accident of Fukushima Daiichi nuclear power plant, Radiocesium

Geomorphological influences of the tsunami and river floods on the lower Natori River unprotected floodplain

Geomorphological influences of the tsunami and river floods on the lower Natori River unprotected floodplain

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The lower reaches of the River Natori were attacked by the tsunami disaster of the 2011 Tohoku Earthquake. The unprotected floodplain along the river is traditionally used for farmlands. This study aims to discuss the geomorphological influences in the unprotected floodplain on the degree and types of damage to the farmlands caused by the tsunami flood and river floods after the tsunami disaster. The tsunami ascended more than 8 kilometers from the river mouth in the present channel. It ascended about 6 kilometers on the unprotected floodplain whose surface is 1 to 4 meters higher elevation than the present river channel. On the floodplain micro-landforms such as shallow ditches of former channels and relatively higher parts of islands are well preserved without artificial change. The tsunami flood ascended selectively through the shallow ditches in the upper part of the tsunami affected reaches. On some islands farmlands survived from the tsunami flood. After the tsunami disaster three times of river floods attacked the floodplain in September 2011 and May and July 2012. The fresh water of the river flood washed away the salinity of the tsunami sediments in the surface soil. It is good for growing vegetables in the floodplain. However, flood water ponded in the shallow ditches every flood event and it continued for a longtime. This severely damaged farmlands.

キーワード: tsunami flood, river flood, 2011 Tohoku Earthquake, unprotected floodplain, micro-landform, River Natori

Keywords: tsunami flood, river flood, 2011 Tohoku Earthquake, unprotected floodplain, micro-landform, River Natori

史跡・吉見百穴の地下軍需工場坑道壁の崩落可能性の検討

Investigation of possible collapse of the wall of the underground munitions factory in Yoshimi Hyakuana historical site

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Deterioration due to salt weathering is a small scale phenomenon in general. However, the weathering might cause a serious failure after rock strength reduction as a result of the weathering for a long time. This study attempted to rock stability analyses on both ceiling and side wall rocks of underground munitions factory in the historical site Yoshimi Hyakuana. In order to evaluate the rock strength, Equotip hardness test and point load test, because it could not make core specimens for uniaxial strength test using collected rock samples from the site. Stability of ceiling wall rocks was analyzed using converted values obtained from these field data and it resulted in fairly stable at present. With considering the recession of the wall due to salt weathering, the calculated stability is somehow reduced. During the salt weathering, the strength of outermost surface of the rock wall decreases significantly. Stability of the outermost rock-wall was examined and resulted in adequate threshold strength of pre- and post-exfoliation.

Keywords: salt weathering, tuff, stability analysis, rock strength, Equotip hardness test, Yoshimi Hyaku-Ana

凍結破砕に与える礫の寸法効果に関する研究 Laboratory experiment of scale effect for frost shattering

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1. はじめに

岩石の凍結破砕に関して、既往の実験には、岩石の種類と物性の関係に着目したものが多く、しかしながら、野外には様々な環境（礫種、礫径、温度等）があり、凍結破砕が活発に進行する条件は明らかにされていない。野外での凍結融解プロセスによる礫の移動に関する観測も多く行われてきたが、礫の移動を十分に説明するためには凍結破砕の影響を考慮する必要もあると考えられる。同じ環境下においても礫の寸法によって凍結破砕の速度が異なり、周氷河環境下における物質移動速度に大きな影響を与えていると思われる。しかしながら寸法の違いが凍結破砕にどのように影響するのかを試みた実験は少ない。そこで本研究では凍結破砕に与える礫の寸法効果を室内実験で検証した。

2. 実験方法

試料には5種類の岩石を異なるサイズの立方体に成形したサンプルを用いる。サンプルはA. 溶結凝灰岩（芦野石）、B. 石灰岩（サブオニエール石灰岩）、C. 凝灰岩（大谷石）、D. 凝灰質砂岩（福島県達瀬町）、E. 砂岩（白浜砂岩）である。凍結破砕作用への抵抗性について、その寸法効果を検証するため、これらの岩石を大きさを変えて成形した。溶結凝灰岩、石灰岩、大谷石の3種類についてはそれぞれ一辺が5, 4, 3, 2, 1の5つの供試体を用意し、凝灰質砂岩、砂岩の2種類についてはそれぞれ一辺が2, 1の2つの供試体を用意した。有効内容積が130%, 器内温度設定範囲が-15 ~ +50, 運転モードとして定値運転とプログラム運転が可能なインキュベータに試料を容器ごとに入れ、最高+15度、最低-15度、周期6時間（1日4サイクル）の温度変化を繰り返し試料に与え、破砕速度や割れ方を観察した。

3. 実験結果

いずれのサンプルも大きさが小さい方が破砕速度が速い傾向にあることが分かった。特にB石灰岩、C大谷石、D凝灰質砂岩でその傾向は顕著であった。A溶結凝灰岩はサイズが1cmのサンプルのみ破砕した。またE砂岩を除く4種類の岩石ではいずれも、一辺が1cmの最も小さなサンプル（A1, B1, C1, D1）だけが400サイクル以内に2mm以上（サンプル本体+破片）の乾燥質量がほぼ0となり完全に破砕した。

E砂岩を除いた4種類の岩種については、破砕しにくい岩石の順番がA溶結凝灰岩、D凝灰質砂岩、B石灰岩、C大谷石であり、密度が大きい順番がA溶結凝灰岩、D凝灰質砂岩、B石灰岩、C大谷石なので、破砕しにくい岩種ほど密度は大きいことが分かった。

また空隙率は小さい順にA溶結凝灰岩、D凝灰質砂岩、C大谷石、B石灰岩であり、破砕しにくい岩種ほど空隙率は小さい傾向にある。E砂岩については密度・空隙率の値がA凝灰岩と近いにもかかわらず、破砕速度が速かった。

4. 考察

全ての岩質で寸法が小さい方が破砕速度が大きい。特に1辺1cmのサンプルは全ての岩型が400サイクル以内ですべて2mm以下粒子となる。この理由として、凍結破砕は岩石の表面から中心部に時間をかけて進行し、岩石が完全に破砕するためには岩石の中心部まで凍結が及ぶ必要があるためと考えられる。空隙率が大きく、密度が小さい岩型ほど破砕速度が大きい傾向にあるが、砂岩のみについては異なった。これは、岩石の空隙率が大きく密度が小さいほど岩石の中心部まで水が浸透する時間が短いためと考えられる。

以上のことから、自然状態において岩石が破砕する理想的な条件として、岩石が多孔質で径が小さく（厚さが1~3cm程度）、-10 ~ +10 くらいまで気温変化し、6時間以上の凍結があることなどが挙げられる。

キーワード: 凍結風化, 凍結破砕作用, 寸法効果, 室内実験

Keywords: frost weathering, frost shattering, size effect, laboratory experiment