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Changes in the surface of granite forming minerals by chemical weathering

Y. TAKAYA
Graduate school of Geoscience, University of Tsukuba
takaya@atm.geo.tsukuba.ac.jp

To examine a mechanism of mineral-water interactions, dissolution experiments were carried out using four granite-forming minerals (annite, quartz, albite and microcline) and granite. For each experiments a small crystal sample ($10.0 \times 10.0 \times 3.0$ mm^3) was treated with pH=1.0, 3.0, 4.0 and 5.0 HCl of 50.0ml at 25.0°C. At the initial stage of chemical weathering dissolution is predominant, resulting in formed surface layer on the weathered mineral surface. Atomic force spectroscopy (AFM) was used to observe micro topography of weathered mineral surfaces. Various precipitates were observed on each condition. For example at pH=1.0 conditions the cation concentration was increased during experiments, but after 1344 hours precipitates shaped of a particle were observed. In the case of experiments using annite, microcline and albite experiments, on the pH=4.0 condition highest volume secondary minerals were produced. X-ray photoelectron spectroscopy (XPS) was used to estimate the chemical composition of these products and dissolved surface layers. Main component of products were amorphous silica, minor products were aluminosilicates.

Key words: chemical weathering, dissolution, precipitation, surface layer, surface analysis, AFM, XPS

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August 2001, Chuo University (Tokyo, Japan)

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Clay Mineral Make-up : Key to Understanding Weathering Process

S.C. GOSWAMI[1]* and B.S. KAPOOR[2]
[1]Department of Chemistry, Dyal Singh College (University of Delhi), New Delhi-110 003, India
[2]Department of Chemistry, University of Delhi, Delhi-110 007, India

The transformation of primary silicates, the building blocks of rocks, into secondary silicates or phyllosilicates, is a complex process. Our knowledge of the structure and properties of these layer silicate minerals has advanced at a much faster rate than our understanding of their origin. This is more true about Indian soils and sediments. Four soil profiles developed on alluvium were examined for their depth-wise clay mineral make-up by X-ray diffraction and optical methods. The clay fractions contained micas (28-52%), interstratified minerals (19-31%), smectitic minerals (15-25%), vermiculite and chlorite (up to 10%). With the exception of the expanding minerals, the silt fraction showed a similar distribution pattern of the layer silicates. These mica dominated soils contained both the di-and trioctahedral varieties of illite. Optical examination of the sand fractions revealed the presence of both muscovite and biotite. Flakes of weatherd biotite were also observed. The trioctahedral nature of the vermiculites and expanding minerals indicated that these were the weathered products of biotite.

Key words: weathering, phyllosilicates, micas, alluvial soils.

Mailing Address of Corresponding Author:
Title and name: 67, Vaishali, Pitampura
Department: Dr. S.C. Goswami
University or other organization: Chemistry
Street or P.O. Box if needed: Dyal Singh College, New Delhi-110 003
City, State, ZIP CODE: Delhi-110 034
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05: Weathering and structural and rock control in geomorphology

Pore-size Distribution of Landform Material and its Geomorphological Significance

T. SUZUKI[1*] and S. HACHINOHE[2]
[1]Institute of Geosciences, Chuo University, Tokyo, Japan.
[2]Center for Environmental Science in Saitama, Kisai, Saitatma, Japan
takas@kc.chuo-u.ac.jp

The pore-size distribution (PSD) for a range from 3.6×10^{-3} μm to $10^{1.5}$ μm in pore size was measured using the mercury intrusion porosimetry for various kinds of landform materials. The pores were tentatively divided into four sub-ranges in pore diameter: i.e. large, α ($10^{1.5}$ μm ≥ α >$10^{0.5}$ μm); medium, β ($10^{0.5}$ μm ≥ β >$10^{-0.5}$ μm); small, γ ($10^{-0.5}$ μm ≥ γ > $10^{-1.5}$ μm); and very small, δ ($10^{-1.5}$ μm ≥ δ ≥ 3.6×10^{-3} μm). The pore volume for the four sub-ranges are denoted as V_α, V_β, V_γ and V_δ (cm^3/g), respectively. A sum of the four is denoted as V_t (cm^3/g). Rocks with similar porosity can have entirely different PSD. The mechanical strength of rock decreases as V_t increases, and for the rocks with similar V_t the strength decreases as the sum of V_α and V_β increases irrespective of the sum of V_γ and V_δ. Permeability coefficient is positively correlated with the sum of V_α and V_β much closely than with V_t. When rocks are weathered, V_γ and V_δ decrease gradually, whereas V_α and V_β increase markedly and V_t increases. This marked increase of V_α and V_β results in the decrease in the mechanical strength of rocks with increasing grade of weathering.

Key Words: Pore-size distribution, landform material, rock properties, weathering

takas@kc.chuo-u.ac.jp
Prof. Takasuke Suzuki
Institute of Geosciences
Chuo University,
Kasuga, Bunkyo-ku, Tokyo 112-8551
Japan

Spatial Distribution of Salt Efflorescence in the Shimoren Kiln, Japan

C. T. OGUCHI [1]*, Y. MATSUKURA [1] and N. KUCHITSU [2]
[1] Institute of Geoscience, University of Tsukuba
[2] Tokyo National Research Institute of Cultural Properties
* chiaki@atm.geo.tsukuba.ac.jp

Salt efflorescence at a brick wall of the two-storied Shimoren Kiln, located about 70 km north of Tokyo, was investigated. The kiln has been out of use and subjected to salt efflorescence since 1971. Salt efflorescence on the four sampling sites was collected on a clear day of February 1999, when the extent of the efflorescence was the broadest through the year. The average temperature and relative humidity for the month measured in the kiln were 4°C and 56 %. The samples were analysed using the X-ray diffractometer to detect constituent minerals. More than ten kinds of salts were detected with an optimal height for efflorescing. Gypsum, syngenite, thenardite, nitratine, hexahydrite and halite existed from lower to upper locations. Darapskite, blödite and eugsterite also patchily existed. Solubility and equilibrium relative humidity of salts are considered to affect the order of salt precipitation. From the viewpoint of solubility, salts in this kiln must crystallise in the order of gypsum, halite, magnesium sulfate and nitratine from the lower to the upper locations. The order of salt efflorescence in the present study, however, was different from this. It may be correlated with the equilibrium relative humidity.
Key words: salt weathering, salt efflorescence, solubility, equilibrium relative humidity

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Soluble Salts of Rocks Forming Coastal Tafoni and Honeycomb in Closed-System Experiments

T. WARAGAI
Department of Geography, College of Humanities and Sciences,
Nihon University
waragai@chs.nihon-u.ac.jp

To elucidate characteristics of dissolution of soluble salts in rocks forming coastal afoni and honeycomb, closed-system experiments were carried out for eleven rock amples, i.e., mudstone, siltstone, sandstone, conglomerate, tuff breccia, pumiceous uff and rhyolite. The fresh rock samples crushed to fragments (diameter of 8-6mm), 100 g in weight, were treated with distilled water under two in water/rock atio. An electrical conductivity of the aqueous solution, as an index of solute oncentration, was measured at several-hour or several day intervals for 30 days. In ddition, the compositions of cations and anions of aqueous solution were analyzed. Experimental results show the following conclusions. (1) The rocks possess soluble alts (chiefly, Na, Ca, Mg, K, Cl, and S), in fluid inclusions. (2) Na^+ (20 - 2000 ppm) nd Cl^- (30 - 5000 ppm) included at high concentration in solution originate in the ave splash and/or the wind blown salts, because the ratios of solute concentration f these ions correspond closely to the ratio of these ions in sea water. (3) The rocks re able to include much the wave splash and/or the wind blown salts in rock pores.

ey words: cavernous weathering, salts, wave splash, wind-blown salts, rock pores

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Abstract Submission Form

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The Distribution of Tafoni and Gnamma Granite Micro-Topography in the Republic of Korea and Japan

Hiroshi Ikeda Nara University

Tafoni and gnamma are two types of micro-topography that can develop in granite. Both types are widely found in the Republic of Korea (R.O.K.). However, these two types of micro-topography are rarely found in Japan. The author wondered why, despite the proximity of Japan and the R.O.K. and the fact that both countries have large areas of granite, this difference in tafoni and gnamma distribution in those two countries exists. To try to answer this question, the following research was conducted.

First, a map of the distribution of tafoni and gnamma micro-topography in the R.O.K. was developed. Both types were found in numerous coastal and inland locations, as well as in both upland and lowland locations. This contrasts with Japan in which they are seldom found. Two major reasons for this difference were considered to exist. The granites in both countries are essentially the same, so one reason may be some difference in the granitic surface. The other may be related to the two countries' climatic conditions.

The granite of the Korean peninsula is part of the continental orogenic-mobile belt which has a low density of joints. Therefore, these two types of micro-topography can easily form on the surface of that country's large granite rock walls and solid rock masses. Furthermore, the Korean peninsula is located on the edge of the Eurasian continent. This results in drier conditions and greater temperature differences than are found in Japan. In Japan which is entirely surrounded by the sea, temperatures are relatively high, heavy rainfalls and snowfalls are frequent, and warm humid conditions predominate. This results in severe weathering which make the development of tafani and gnamma micro-topography difficult. Key words: tafoni and gnamma granite weathering Korea Japan

Mailing Address of Corresponding Author:
Title and name
Department
University or other organization
Street or P.O. Box if needed
City, State, ZIP CODE
Country

HIROSHI IKEDA
PROFESSOR
NARA UNIVERSITY, DEPT. OF GEOGRAPHY
1500 MISASAGI-CHO NARA-CITY JAPAN

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Seasonal difference in erosion process of a bedrock channel on the Boso Peninsula

M. TODA
The Faculty of Letters, Rissho University
QYF03027@nifty.ne.jp

The Obitsu River on the Boso Peninsula, Japan is incised into Tertiary rock. In Torii-zawa, the upper part of Obitsu, massive sandstone is exposed on channel floor, where direct measurement of erosion depth has been in progress since 1992. Stream usually flows on lower portion of almost flat channel floor. And here seems to be the pass of bed-load sediment during flood. Lower portion was eroded after big flood events. Such events occur mainly in summer and autumn, rainy season. During winter slightly higher portion is out of water and sometimes freeze. Because of frost heave R-value of Schmidt hammer of bedrock out of water is much smaller than that of in water. In late winter and early spring, higher portion was eroded after flood events which are not so big. This erosion products flakes of sandstone. On this channel, erosion process is different seasonally. In summer and autumn lower portion is eroded by abrasion during big flood events. In winter and spring, higher portion is weakened by frost heave and eroded by plucking during flood.

Key words: abrasion, bedrock channel, erosion, frost heave, plucking

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On the Definition of "Stripped Surface"

Isao AKOJIMA
Department of Environmental Geography, Faculty of Human Culture and Social Sciences, Yamagata University
akojima@human.kj.yamagata-u.ac.jp

For a long time, it has been accepted that there are remnants of peneplain surface formed during the end of Tertiary period in Japan. But the other explanations were concluded in the tops of mountains in the Kibi range, southwest Japan, the one of typical examples of uplifted peneplain. The undulating surfaces are the resurrected surface of the base of Miocene thick marine and fluvial sediments covering the resistant Paleozoic and Mesozoic basement rocks. The author had described the relief map of buried topography under the Miocene sediments in the regional scale, unit size of which is 10'x15', and in the local detailed map scale of 1:25,000. The author is proposing the definition of stripped surface as follows; When the thickness of patches of layer remaining on the erosion surface is equal to or less than the contour interval of the map explaining the erosion surface, the surface is to be called as the stripped surface from neighboring buried topography. This definition may be applicable to any mapping scale.
Key Words: erosion surface, stripped surface, selective erosion, rock control, Kibi mountains

Geomorpholoy of the Northern Part of the Eastern Desert of Egypt

G.M.SALLOUM
Geology Dept. Faculty of Science, Al Azhar University , Cairo,

The geomorphological studies carried out involved two main aspects namely : relief analysis and drainage analysis, the latter was dealt with qualitatively and quantitatively to elucidate the geomorphic history of the studied landforms. Relief analysis showed that the area underconsideration as a whole consists of high, medium and low relief units, it may be broadly divided into the following geomorphological units from the northern to the southern limitations:The northern E-W block.The intermediate E-W block.The southern block which forms an E-W escarpment.The northern and southern depressions. The eastern coastal plain. On the other hand, the drainage analysis made on eight selected basins, showed that the geometric progression is not observed in the higher orders. This may be interpreted as the result of complex evolutionary history of these basins, possibly due to tectonic causes, whereas the bifurcation characteristics of the studied basins showed that a major part of the area that drained by Wadi Hof basin is roughly of rather moderate topography than that drained by the other basins. Moreover, the drainage density of the analyzed basins showed that there is a high density values in some of these basins (e.g. Wadi Moftah and Wadi Um Thamil) and a relatively low density values in some of the others (e.g. Wadi Um Atlah) due to the nature of the low and medium resistance of the sedimentary substratum.

Relationship Between Geological-Structural Framework and Landslide Types in Abruzzi (Central Apennine, Italy)

L. D'ALESSANDRO, M. BUCCOLINI*, R. BARBERI, E. MICCADEI, T. PIACENTINI AND URBANI A.
Dipartimento di Scienze della Terra, Università degli Studi "G. d'Annunzio", Chieti.
buccolini@dst.unich.it

In Central Apennine chain (Central Italy) the morphogenetic processes began their activity in Lower-Middle Pliocene during the uplift and the emersion of the chain; these processes go along with the development of important dip-slip fault systems with strong throw. Thus the geomorphologic evolution is deeply influenced by lithology and tectonics. In order to study the influence of the bedrock geological evolution on the distribution and typology of landslides, the Abruzzi region has been chosen: here you can recognise a huge variety of stratigraphic successions and several structural elements, both still active or not. In the inner part of the chain the landslides are influenced by the presence of competent rocks deformed and displaced by faults (thrust, strike-slip and normal faults). In the outer part, the chain front, the landslides are typically influenced by the presence of multilayered rocks monoclines alternating competent and soft rocks and by the high topographic relief. In the coastal area the landslides are mainly related to the lithology: competent rocks (conglomerate, sandstone and travertine) outcrop on the hill top and overlie clay and silt.
Keywords: Italy, Central Apennines, geomorphology, landslides.

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The Difference of the Formation of Soil Layers and Its Effect on Soil Slips in Granite and Gneiss Slopes, Korea

T. WAKATSUKI[1]*, Y. TANAKA[2] and Y. MATSUKURA[3]
[1] Graduate School of Geoscience, University of Tsukuba
[2] Department of Geography, Fukui University
[3] Institute of Geoscience, University of Tsukuba
*waka@atm.geo.tsukuba.ac.jp

The relationships among lithology, soil layers and dimensions of soil slips (depth and angle) were investigated in Jurassic granite and Precambrian gneiss slopes in the suburbs of Seoul, Korea. The slope angle of pre-slip profile and the average depth of slippage in granite are estimated to be about 35-40° and 1 m, respectively. Whereas, those in gneiss scars are about 25-30° and 2 m. Weathering products are coarse in granite slope and fine in gneiss slope in reflecting the grain size of bedrocks: soil layers of failure (shearing) plane in granite slope have a coarse material with high angle of shearing resistance (ϕ) and small cohesion (c) and soil layers in gneiss slope have a fine material with low ϕ and large c. It is suggested that these properties of soil derived from weathering seems to control the difference of dimensions of soil slips.

Key words: gneiss, granite, soil slip, weathering, rock control

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