

## PALEO-ENVIRONMENTAL HISTORY AND KOSA (DUST AND SAND STORM) FLUCTUATION AT ARID - SEMI-ARID REGIONS IN EAST ASIA

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There are two methods to monitor environmental changes and desertification at arid and semiarid regions. The first one is the short-term monitoring, and examined the changes during several years or decades by meteorological, hydrological, geophysical and geochemical observations. The second one is the long-term monitoring, and presumed changes of environment during hundreds or thousands years using geologic and geographical methods. Although a lot of expeditions have reported short-term changes, the reports for long-term environmental changes have been limited because it takes a lot of efforts to take efficient samples to presume in detail environmental histories.

Department of Earth and Planetary Sciences, Kyushu University has started international research project to make long-term monitoring of desertification in East Asia to correspond with the East Asian Environmental Problems Project of Kyushu University. In cooperation with Mongolian Academy of Sciences, National University of Mongolia, Xinjiang University in China, the filed surveys have been done to obtain samples for long-term monitoring at lakes, ponds and marshes in Mongolia and north western China using geological and geographical methods. Our researches presumed long-range (about hundreds or thousands years) changes of the lowering of lake levels and under ground water levels, the reducing of forest areas and the expanding of deserts in those regions. The desertification has been accelerated in these two hundred years in both regions.

Keywords: Xinjiang Uyghur, Climatic changes, Desertification, Mongolia, The Global Warming, KOSA (Dust and Sand Storm)

## Visualization of liquefied layers using GPR in Watarase flood plain, central Kanto

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At the Watarase flood plain, central Kanto, there were many cracks and sand mounds caused by liquefaction in 11, Mar 2011. Various liquefaction models have been proposed based on a profile observation of the old liquefaction and experiment. This study tried visualization of liquefied underground layers. We carried out boring investigations and GPR explorations in Watarase flood plain. Core samples show typical lower river deposits. There was loosely-deposited sandy layer near the groundwater level which was 2m deep. We traced liquefied layers using GPR (Ground Penetrating Rader) which can display the reflection profile about 5m deep with frequency of 250 MHz. By the comparison of core records with GPR images, we confirmed that GPR image is applicable to the distinction of sand, sandy clay and clay layers. Moreover, we found sharply shaped reflection patterns in sandy layers near 200cm deep. Width and height of the pattern is 0.5-2.5m and 0.2-0.95m respectively. Interval of sharp-shaped reflection patterns are 1-20m. The interval is related between the GPR survey line and the location of deformed layer. We considered that these sharp shaped reflection patterns were shown liquefied sandy layers. GPR is thus available for the visualization of the invisible liquefied layers.

Keywords: GPR, Liquifaction, 3.11 Mega quake

## Coastal geomorphology as a proxy of large paleothrust earthquakes along the Andaman Trench

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Estimating hazards from earthquakes and tsunamis along subduction zones is of significance to coastal communities. Here, we discuss the coastal geomorphology of selected sites in the Andaman Islands, which lie within the rupture zone of the 2004 Sumatra-Andaman earthquake. As part of the near-source region, these islands witnessed considerable geomorphic changes, both before and after the 2004 earthquake, which may be related to the maturity of a megathrust subduction zone earthquake cycle. Assuming that these geomorphic landforms are properly preserved and attributed to the right sources, it is possible to build the history of large paleothrust earthquakes for the Andaman Islands. Given that these landforms are a result of similar processes through time, our sites are broadly divided as regions that subsided or were uplifted in 2004.

At Hut Bay and Interview Island, uplifted coralline terraces were mapped, as were stream inlets that cut through the newly-formed as well as older terraces. Samples collected from these locations include wood pieces from trees embedded in the stream bank, shells from pebble-rich layers along the exposed bank as well as coral fragments from the terraces themselves. At Port Blair, large stretches of land subsided in 2004. While several farmlands remain inundated beneath the present-day tidal-line, several mangroves trees died in situ, their roots being preserved in the shallow subsurface. Along a stream bank, a similar root horizon was identified 1m below the present day surface which was sampled at multiple locations. Additionally, a shell sample was collected from within the paleo root-zone.

The ages of these samples were estimated using AMS radiocarbon dating, and they cluster at AD 1100, AD 1500, and AD 1900. Though these geomorphic landforms may be the result of other coastal processes, either regional or global, we believe that these ages, with corroborating evidence from several studies in the Andaman Islands and from coastlines in Sri Lanka, mainland India, Sumatra, and Thailand are representative of large earthquakes in recent history, some of may have been tsunamigenic.

**Keywords:** 2004 Sumatra-Andaman earthquake, Coastal geomorphology, Andaman Islands, Uplifted terraces, Subsided lowlands, Paleothrust earthquakes

## Volumetric changes of various rocks during weathering and their geologic significance

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A rock volume may change during weathering, which would have various importance in earth surface processes. However, little is known on the volumetric change. We summarize our research results of various rock types and refer to its geomorphological importance. Basic idea is so-called isocon concept, which assumes immobile chemical elements during weathering and calculate a volume change from density and chemistry of rock before and after weathering (Grant, 1986). We assume TiO<sub>2</sub> is the immobile element.

### Granitic rocks:

Volumetric change may be different between granite and granodiorite/quartz diorite. White et al. (2002) reported that granodiorite and quartz diorite are isovolumetric during weathering. Chigira (2002) reported that granite expands 50% during weathering, which is consistent with Folk and Patton (1982) who estimated the volume change from the inflection of a pegmatite vein in a weathering zone. These expansions lead to spheroidal weathering or micro-sheeting.

### Sandstone:

Matsuzawa (2008) studied the weathering of sandstone of the Cretaceous Izumi Formation in Ehime and estimated 20-30% expansion during weathering, which closed joint openings.

### Mudstone:

Calculation from the data of Chigira (1988) for the Quaternary Haizume Formation in Niigata suggested that mudstone expanded 10-30% during weathering in the upper part of the dissolved zone. Such expansion may facilitate downslope soil creep.

### Vapor-phase crystallized tuff:

Calculation from the data of Chigira et al. (2002) for vapor-phase crystallized tuff of the Shirakawa ignimbrite in Fukushima suggested its weathering was isovolumetric except for the topmost part, in which fabric collapsed and the rock shrank.

### Tuff breccia:

We studied the weathering of tuff breccia of the Miocene Tomari Formation in Aomori, which suggested that it occurred with 20-50% expansion. So-called active faults in the Higashidori nuclear power plant site are apparent active faults made by rock expansion during weathering.

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Keywords: weathering, volumetric change, active fault

## Use of rock properties in classification of weathering grades: A Sri Lankan case study

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Rocks utilised for the Samanalawewa project, have undergone severe weathering after they were excavated late 90's. The rate of weathering is incomparably high with respect to the normal soil formation processes. Different weathering grades of rocks that were used as construction materials, foundation materials and road aggregates are found in the project area. Consequently, they have been threatening to the sustainability of the project. The access adit and rip-rap zone of the dam are vulnerable to damage owing to the rapid weathering. Even though charnockite, marble, biotite and garnet granulitic gneisses were utilized for the project, only pyrite-sillimanite-garnet gneiss has shown extensive weathering. The rapid weathering of this rock is being observed since the commissioning of the project. Rocks were subjected to a petrographic study under the optical microscope. Point load strength, slake durability, loss on ignition and water content tests were employed to distinguish weathering grades. Water-rock interaction was experimented to study the pyrite oxidation. Comparatively to charnockite and marble, pyrite-sillimanite-garnet gneiss is weaker according to point load strength and slake durability indices. Rock strength and chemical properties illustrates that the weathering process takes place at a rapid and a normal stages. It is mainly observed on set of weathering. Corroded grains boundaries and decayed minerals in the rock are consequences of weathering induced by the acidic water generated by pyrite oxidation. The abundance of pyrite in pyrite-sillimanite-garnet gneiss is uneven. Thus, different weathering grades of the rock can be seen over the study area. Extensive fractures, which might be generated during tectonic activities or during excavations, facilitate better interaction with the atmosphere. It also effectively reduces the strength of the rock. It is another reason for differential weathering.

Keywords: Point load strength index, Rapid rock weathering, Loss on ignition, Samanalawewa project, Pyrite oxidation, Pyrite-sillimanite-garnet gneiss

## Experimental Study on Deterioration and Durability of Bricks due to Salts

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In Vietnam, heavy construction materials such as bricks are often used because there are many floods. However, the deterioration due to weathering has been found at general houses and historic brick buildings. To investigate deterioration of bricks used in these buildings, the present study performed salt weathering experiments using 6 bricks produced in Vietnam, Japan and China; red brick (RD), beige brick (BG), Vietnam brick (VN), amber brick (AB), brown brick (BR) and refractory brick (RF). These bricks were cut into cylindrical with a size of 3.5 cm in diameter and 7.0 cm in height. After examined rock properties such as physical, mechanical chemical and mineralogical characteristics, two types of salt weathering experiments were performed under 15-35 °C and 20 °C atmosphere. The saline solutions used in this study are 4%-Na<sub>2</sub>SO<sub>4</sub>, 8%-Na<sub>2</sub>SO<sub>4</sub>, 10% Na<sub>2</sub>CO<sub>3</sub>. Results of the experiments show that the deterioration mechanism of bricks is explained that 1) when the salt is absorbed and crystallizes inside brick, micropores of brick are extended by crystal expansion pressure and make cracks, 2) strength of the brick increases slightly by salt crystallization, but decreases gradually by salt deliquescence, and 3) with repeating of 1) and 2), bricks will be damaged. Even chemical and the mineralogical characteristics are almost equal except for BG, physical and mechanical characteristics are different, which controls durabilities of these bricks.

Keywords: salt weathering, brick, Vietnam, experiment, durability factor, salt susceptibility index