[論文] 渡名喜島の組織地形

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Structural Landforms of Tonaki Island, Okinawa

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Introduction

Major factors affecting landform formation are (1) the assailing force of geomorphic agents acting on the ground surface, (2) the resisting force of material forming the ground surface, and (3) the duration of geomorphic agents. If assailing force of geomorphic agents and the duration of geomorphic agents act evenly, landforms are controlled by resisting force of landform-forming materials. These landforms are called structural landforms. Structural landforms are formed on Tonaki Island, Okinawa Prefecture.

This study examines relationship between structural landform and landform-forming materials and tries to clarify structural landform formation.

Relation between structural landform and landform-forming material

Topographic and geologic sections of Tonaki Island are shown in Fig. 1. Structural landform develop on there. The ridges are composed of limestone and dolostone, while the furrows are made of phyllite and porphyritic rock.

Mechanical properties of landform-forming materials

Soil hardness and shear strength were examined as resisting force of landform-forming materials. Because it was difficult to approach to phyllite weathered soils which form furrows, soil hardness and shear strength of limestone weathered soils and porphyritic rock weathered soils were measured (Fig.1). Thickness of limestone weathered soils and porphyritic rock weathered soils are several tens centimeters to several meters.

Soil hardness of landform-forming materials was measured under natural water content. Soil hardness of limestone weathered soil is 14mm, and that of porphyritic rock weathered soil is 19mm. Soil hardness of porphyritic rock weathered soil is larger than that of limestone weathered soil.

Shear strength of limestone weathered soil and porphyritic rock weathered soil was tested by using in-situ vane shear apparatus under natural water content and saturated conditions. Results are shown in Figs. 2 and 3. Shear strength, i.e., cohesion (*c*) and angle of internal friction (ϕ) of limestone weathered soil are 300gf/cm^2 and 0° under natural water content, respectively. Cohesion (*c*) and angle of internal friction

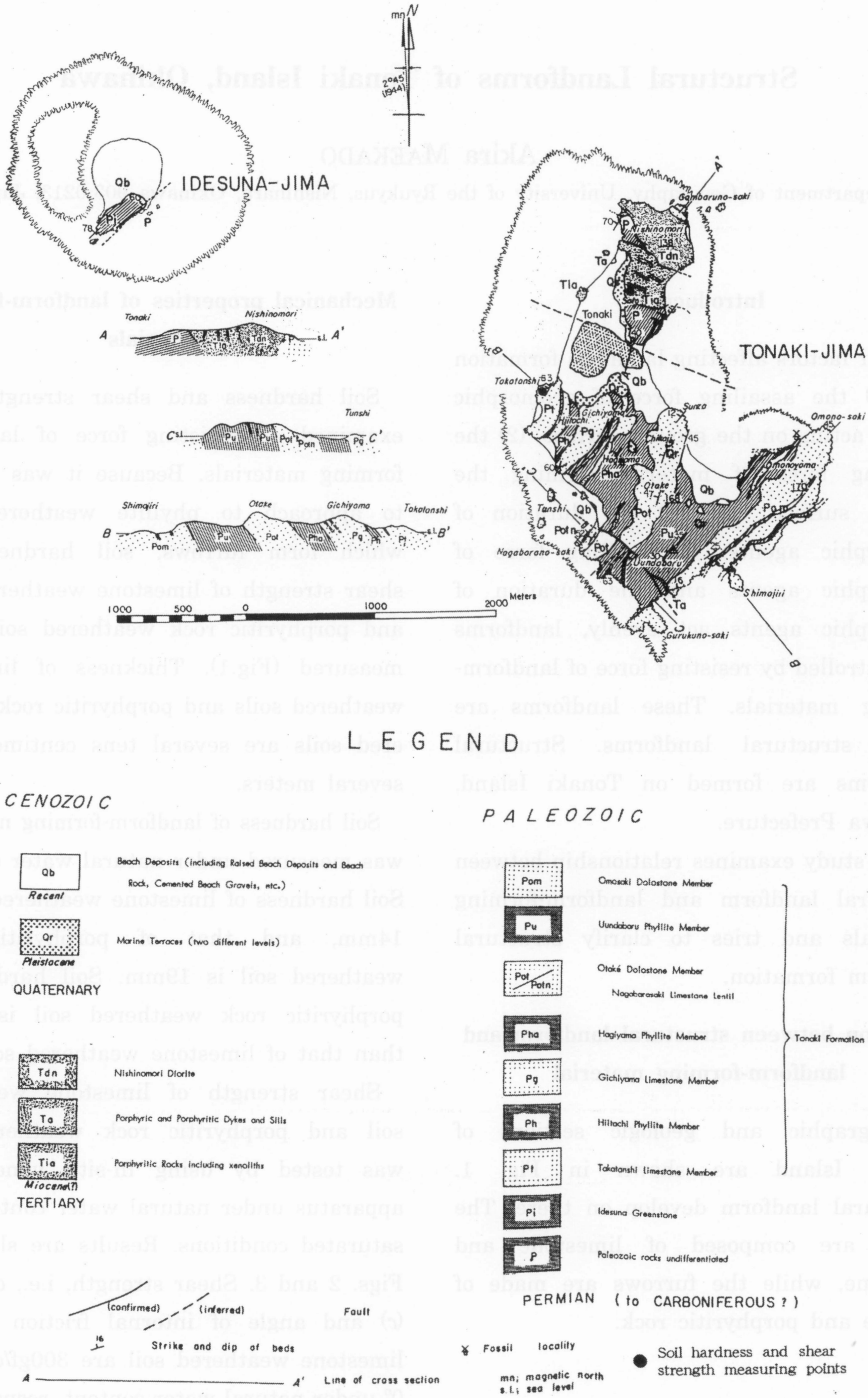

Fig. 1. Geology, topographic and geologic section of Tonaki Island (after Konishi, 1964).

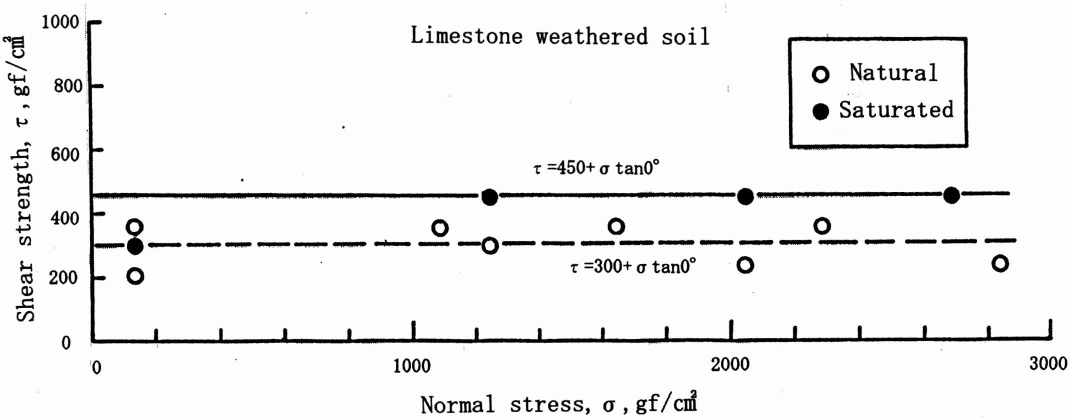

Fig. 2. Shear strength of limestone weathered soil.

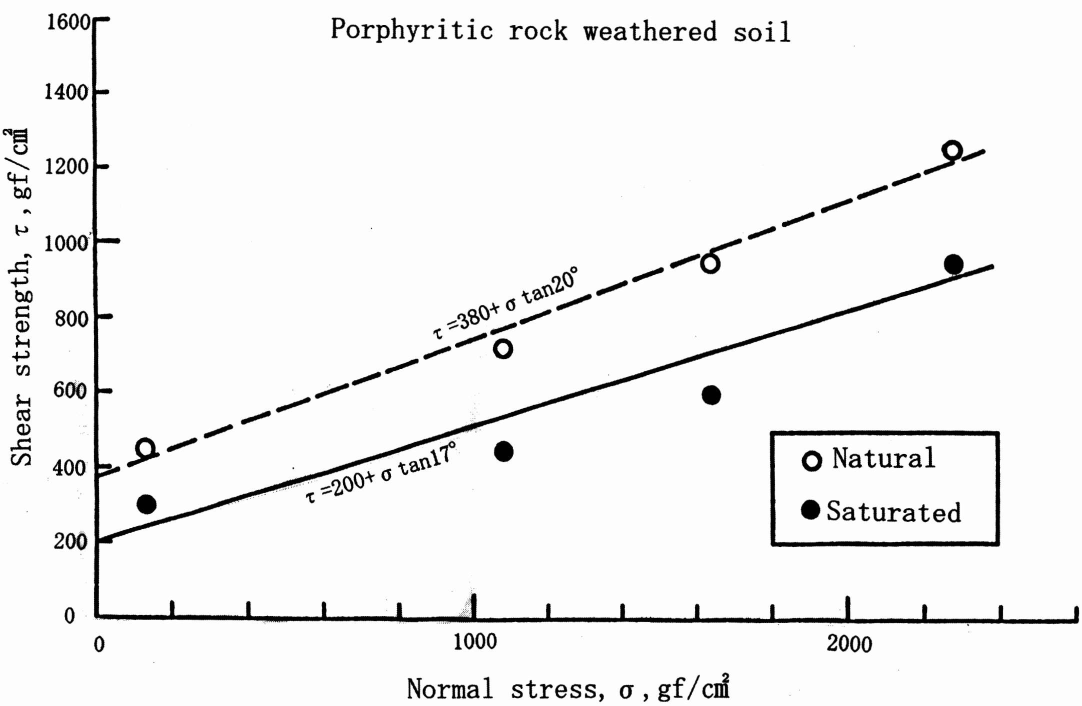

Fig. 3. Shear strength of porphyritic rock weathered soil.

(ϕ) of porphyritic rock weathered soil are 380gf/cm^2 and 20° under natural water content, respectively. Under saturated conditions, cohesion (*c*) and angle of internal friction (ϕ) of limestone weathered soil and porphyritic rock weathered soil are 450gf/cm^2 and 200gf/cm^2, 0° and 17°, respectively. Shear strength of limestone weathered soil and porphyritic rock weathered soil are nearly equal under low normal stresses. However, shear strength of porphyritic rock weathered soil is larger than that of limestone weathered soil under high normal stresses.

Structural landform formation

Generally speaking, if assailing force of geomorphic agents and the duration of geomorphic agents act evenly on ground surface, stronger rocks or soils form ridges, i.e., high elevation. If structural landforms are formed by erosion of limestone and phyllite (porphyritic rock) weathered soils, weaker rocks having low soil hardness and shear strength form furrows, i.e., low elevation. Because Tonaki Island is small and landform-forming material age is same, it is considered that assailing force of geomorphic agents and duration of geomorphic agents act evenly on Tonaki Island. However, porphyritic rock (phyllite) weathered soils having larger soil hardness and shear strength form furrow. Relationship between structural landform and landform-forming materials shows opposite relationship. This indicates that Structural landform formation of Tonaki Island is controlled by the factor except landform-forming material strength.

Reference

Konishi, K. (1964): Geologic notes on Tonaki-jima and width of Motobu belt, Ryukyu Islands. *Sci. Rep. Kanazawa Univ.*, **9**(2), 169-188.

渡名喜島の組織地形

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渡名喜島にみられる組織地形と構成岩石との対応関係を調べ，組織地形の成因を考察した．組織地形の尾根部は石灰岩，苦灰岩で構成され，谷部は千枚岩で構成される．千枚岩風化土壌へのアプローチが困難であったため，石灰岩，班岩風化土壌の土壌硬度，せん断強度を調べた．その結果，自然含水比，飽和状態のいずれの含水比でも班岩風化土壌の土壌硬度，せん断強度が石灰岩風化土壌のそれより大きいことがわかった．

石灰岩，千枚岩（班岩）が風化し，その風化層の侵食によって組織地形が形成されるとすれば，土壌硬度・せん断強度の小さい石灰岩が谷部，両強度の大きい千枚岩（班岩）が尾根部を形成するはずであるが，地形と構成岩石風化土壌の強度とは逆の関係になっている．今回の調査結果からは，風化層の強度から組織地形の成因を説明できないことが判明した．