PHYSICAL PROPERTIES OF WEATHERED TUFF BRECCIA ON THE LANDSLIDE TRIGGERED BY RAINFALL IN ONO, HITA, OITA PREFECTURE

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1. INTRODUCTION

On July 5th-6th, 2017 heavy rainfall occurred in Hita, Oita Prefecture until the cumulative rainfall is 402.5 mm. On the graphic of rainfall (Fig. 1), the highest rainfall occurred in July 5th around 7 pm. This heavy rainfall was formed and due to the influence of warm, very moist air flowing towards, and the rain was blowing. Many landslides occurred triggered by this heavy rainfall. In this paper, we focused on the landslides which occurred in Ono.

Landslide in Ono Area also has a relation with the weathering of rocks. Weathering of rocks is a destructive process whereby debris of various size, compositions, and shaped is formed (Reiche, 1945; Keller, 1957).

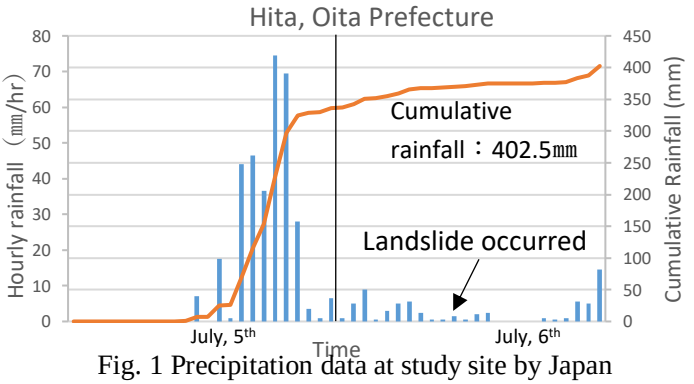

Fig. 1 Precipitation data at study site by Japan Meteorological Agency

2. RESEARCH AREA

Landslide location in Jyogu Mountain (645 m) and near with Ono river (Fig. 2) (https://gbank.gsj.jp/seamless/v2full/). Dimension of this landslide is 30,000 m^2 with volume landslide 300,000-450,000 m^3 (Japan Society of Erosion Control Engineering, 2017).

This landslide contains of two kinds of rocks; tuff breccia and andesite (Neogene period 7 Ma to 1.7 Ma). In this research, we focused on material tuff breccia which has a red colour and the grain size is from sand to gravel (0.075-75 mm).

Tuff breccia is easily to investigate of stage weathering which is important in this research. Furthermore, we also can predict the location of slippage plane in tuff breccia materials.

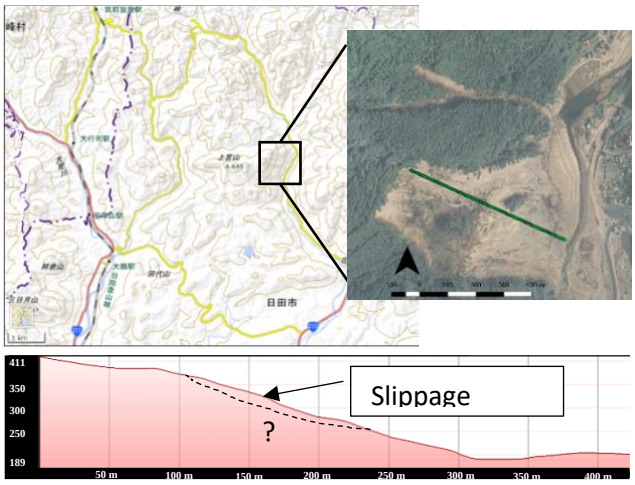

Fig. 2 Ono landslide is located in N 33°23’23.53” E

3. METHODS

The research made by relation between field method and soil properties methods. The field method in this area is soil hardness test used soil hardness tester, Yamanaka Fujiwara Seisakusyo, Ltd. The soil properties methods are Atterberg limits analysis, density of soil particles, ignition loss and grain size distribution analysis by Japanese Geotechnical Society. The samples of the soils were taken from landslide zone. We used the mesh methods to separate the fine grain for analyse and also mashed the course grain with hammer to get more fine grain for analyse (Photo 1).

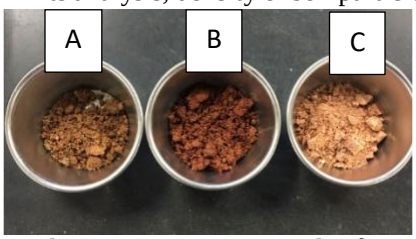

Photo 1. Fine grain samples for physical properties analyse

4. RESULTS AND DISCUSSION

Heavy rainfall in Ono Area triggered the weathered tuff breccia to collapse. The landslide was not occurred at the same time with the highest peak of hourly rainfall (at 7 pm in July 5th). The landslide occurred after the heavy rainfall occurred (at 10 am in July 6th) (Japan Society of Erosion Control Engineering, 2017).

The stages of weathering on tuff breccia in landslide area is divided into three soil layers with two weathering stages (Photo 2). Table 1 shows the results of physical properties analysis in Tuff breccia materials at Ono Area. Weathering stage is divided by different of colour, grain size and soil hardness.

A layer (brown colour) and B layer (red colour) are decomposed stage. A layer has a grain size from sand to fine gravel (0.075-4.75 mm) and B layer has a grain size from sand to medium gravel (0.075-19 mm). At the stage of decomposed granitoid, granular disintegration takes place, and crystals become increasingly detached from each other (Durgin, 1977). C layers with the white pink colour, grain size from sand until coarse gravel (0.075-75 mm). The weathered zone develops outward from the joints and isolates blocks or boulders of fresh rock to form corestones. In some areas, corestones become

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Table 1 Physical properties analysis results

Soil Layer	Density of soil particle (g/cm^3)	PI	LL (%)	Li (%)	Soil hardness (mm)
A	2.717	9.72	68.84	15.489	25.0
B	2.807	11.85	63.45	15.375	20.7
C	2.752	7.80	53.81	16.925	31.1

remnants on the ground surface and may roll down slopes during rainy periods, causing extensive damage (Barata, 1969; De Costa Nunes, 1969). Physical properties analysis results show the different results in PI, Li and Soil hardness between three soil layers.

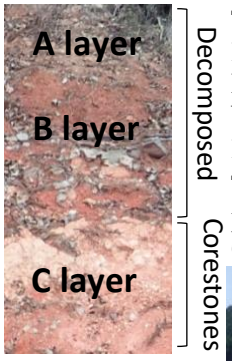

Photo 2. Stages of weathering on tuff breccia in landslide surface

The ignition loss data was taken from three samples and soil hardness test was taken from ten points. In plasticity index value, from A layer to B layer the value is increase but the value decrease from B layer to C layer. In ignition loss and soil hardness value, from A layer to B layer the value is decrease but the value increase from B layer to C layer.

In Photo 3 we can see the soil layers have a slope, B layer has a slope 49° and C layer has a slope 35°. The depth of C layer with slope 35° is 60 cm (Photo 2). The different of slope show there is collapse part of the soil layers. From topography photo (Photo 3), the slippage plane is located between B and C layer.

Photo 3. Slippage plane in research area (The square is the location of the stages of weathering on tuff breccia in landslide area (Fig. 3))

5. CONCLUSION

Soil layers in research area divided into three layers. The different of weathering stages makes the different results in physical properties analysis. The different results show the location of slippage plane. Slippage plane located between the B and C layer. The different in plasticity index value, liquid limit value, and ignition loss value are the reason for the assumption of slippage planes location. Furthermore, the different of weathering stage such as grain size particle and soil hardness value also another reason for the assumption. The slippage plane for weathered tuff breccia has a high plasticity index, low ignition loss, and low soil hardness value.

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