Lithological Controls on Mechanisms of Shallow Landslides Triggered by an Extreme Rainfall Event:

Comparative Survey on Hillslopes underlain by Granite and Granodiorite in the Northern Abukuma Mountains

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The bedrock lithology dictates physical characteristics and production rates of regolith, which leads to characteristic regolith depending on the bedrock lithology. Differences in the properties of regolith cause different hydro-geomorphological processes through rainwater infiltration, which influences the differences in the mechanism of shallow landslides caused by extreme rainfall. Due to the extreme rainfall caused by typhoon in 2019, shallow landslides occurred extensively in the northern Abukuma Mountains which were underlain by granitoids. It has been pointed out that granodiorite slope area has a lower spatial landslide density than granite slope area, but many shallow landslides occurred in the slope area underlain by granodiorite in the Kitakami belt. In this presentation, we point out that the differences in mechanical and hydraulic properties of the shallow subsurface structures of slopes would make differences in the mechanism of shallow landslides in the slope area underlain by granite and granodiorite bedrock.

The shallow subsurface structures on the slopes were revealed by observation at the field, cone penetration test, geotechnical test in the laboratory. Pore water pressure fluctuations due to rainfall were revealed by hydrological monitoring using tensiometers.
On the granite slopes, the soil-layer has a small Nc value (Nc < 5). It has also high permeability and low water retention, suggesting it has high drainage capacity. The weathered bedrock beneath the soil-layer is rather hard (Nc > 10). Thus, there is a mechanical and hydraulic discontinuity between the soil-layer and the weathered bedrock. The results of hydrological monitoring suggests the infiltrated rainwater is likely to be easily drained above the weathered bedrock. Therefore, a sliding surface would often be formed near the discontinuity. However, a sliding surface does not often form because the drainage capacity of the soil-layer is high.
On the other hand, there is no clear mechanical and hydraulic difference in the soil-layer on the granodiorite slopes. However, there is a discontinuity in the soil-layer at which mechanical and hydraulic properties slightly change. According to a result of hydrological monitoring, a lateral infiltration flow that causes an increase in pore water pressure occurs near the slight discontinuity. The increase in pore water pressure causes a cohesion to decrease, which leads to the formation of sliding surfaces. Moreover, the shearing resistance angle is low value at the potential sliding surface. This may have promoted occurring shallow landslides on the gentle slope area.

These facts suggests that the shallow subsurface structures in the slopes are different with bedrock lithology. It is also possible that the difference in the shallow subsurface structures on the slopes make a difference in the characteristic of shallow landslides triggered by extreme rainfall.

Keywords: Shallow landslide, Shallow subsurface structure, Granitic rock, Abukuma mountains

