Soil Characteristics of Two Fluidized Landslides Occurring in the Snow-covered Period

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INTRODUCTION

In a snow-covered, Neogene mudstone area in Japan, numerous landslides are induced by snowmelt water in winter or spring. In some cases, the landslide mass fluidizes and travels a long distance. The triggers of fluidized, long-travelling landslides are the moisture and soil properties of the traveled mass, and the topographical features of the transfer area[1)]. In this study, we focused on the soil properties of traveled mass and investigated grain size distribution in the source and accumulation areas by testing soils tests for two landslides that occurred during snow-covered and snow-melt periods.

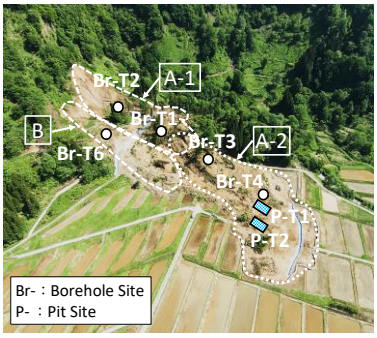
METHOD

We investigated two landslides in Niigata prefecture: the Tanne-Hirota Landslide, which occurred in Itoigawa City, and the Kamikozawa Landslide, which occurred in Myoko City. We conducted soil tests for grain size and consistency, with 5 boring core soil samples and 2 pit soil samples for the Tanne-Hirota Landslide. We conducted soil tests on 3 boring core soil samples in the same manner for the Kamikozawa Landslide. We then compared the soil characteristics of the source and accumulation areas of both landslides from the soil tests results.

OUTLINE OF LANDSLIDES

1. Tanne-Hirota Landslide

The Tanne-Hirota Landslide occurred on April 24, 2015. Photo 1 is a panoramic view of this landslide and the sites where boring and pit samples were taken. The head of the landslide was near the geological boundary, between the lower mudstone and the upper andesitic lava and pyroclastic rock, and the landslide was approximately 170 m long and 100 m wide (A-1 and B areas on photo 1). Given the sediment conditions of the traveled landslide mass, a portion of the moving body traveled downwards (A-2 area on photo 1), and the length from the crown to the toe was approximately 380 m. The angle formed by the horizon and the line from the toe to the crown was approximately 15 degrees.



2. Kamikozawa Landslide

The Kamikozawa Landslide occurred on April 8, 2015. Photo 2 is a panoramic view of this landslide. The source area of the landslide was approximately 100 m long and 80 m wide. The length from crown to toe was approximately 210 m, and the angle formed by the horizon and the line from the toe to the crown was approximately 19 degrees. A portion of the landslide mass crashed into the opposite slope of the river and was deposited in the upper and lower stream. If there had not been an opposite side slope, the traveled distance and range could have extended further.

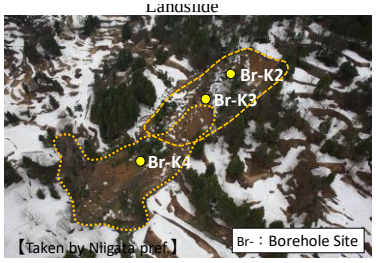
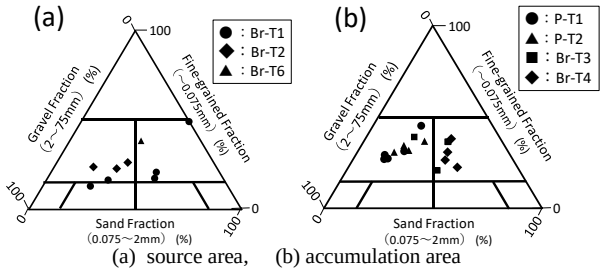


Photo 2 Panoramic view of the Kamikozawa Landslide

RESULT

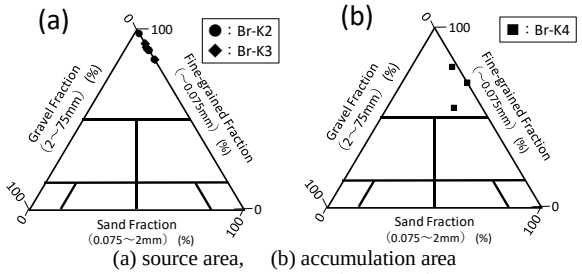
1. Grain size distribution

Fig. 1 and **2** present the grain size distribution of samples in the source and accumulation areas from the Tanne-Hirota and Kamikozawa Landslides, respectively. In the Tanne-Hirota Landslide, the fine-grain fraction in both the source and accumulation areas was distributed between 15% and 50%, and the sample was classified as gravel with fine, and sand with fine. Conversely, the both samples in the source and accumulation areas from the Kamikozawa Landslide consisted of more than 50% fine-grain fraction, and was classified as fine-grained soil.



(a) source area, (b) accumulation area

Fig. 1 Grain size distribution of samples from the Tanne-Hirota Landslide

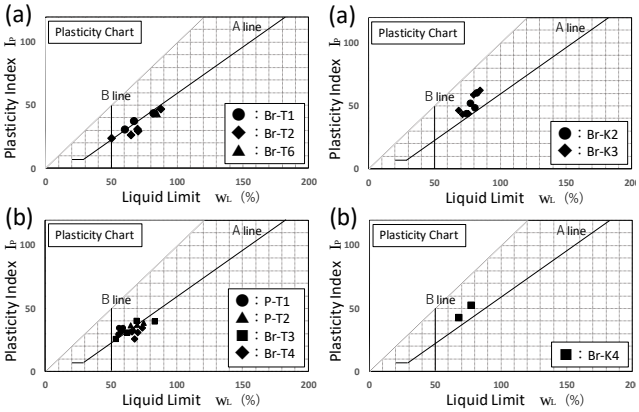


(a) source area, (b) accumulation area

Fig. 2 Grain size distribution of samples from the Kamikozawa Landslide

2. Soil consistency

Fig. 3 and **4** showed the results of the soil tests (liquid limit and plasticity index) on samples from the Tanne-Hirota and Kamikozawa Landslides, respectively, as a plasticity chart. They show that the samples from the source areas of both landslides have the same soil consistency characteristics as samples from the accumulation areas. Samples from the Tanne-Hirota Landslide were near the A line (I_P=0.73(w_L-20)), while samples from the Kamikozawa Landslide were above the A line and have the features of cohesive soil.



DISCUSSION

The soil properties of the matrix of gravels in the source and accumulation areas of both landslides were similar. This suggested that the soil properties of the traveled mass were almost unchanged in the fluidizing process. Furthermore, the liquid limits in the source and accumulation areas of both landslides were also similar, although the grain size distribution matrix of gravels differed, respectively.

CONCLUSION

The consistency of matrises such as the liquid limit, rather than grain size distribution, influences landslide mass fluidization. To determine the soil characteristics of the fluidized landslide mass in detail, further investigations, such as studies about the relationship between water content and fluidity of fluidized and non-fluidized landslide masses, are required.

REFERENCE

1)Takashi KIMURA et al: Topographic features of source and transfer-deposition areas of long-travelling landslides, Landslides-Journal of Japan Landslide Society, Vol.53, No.2, pp.1-12, 2016

Keywords: fluidized landslide, grain size distribution of matrix, soil consistency