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The Relationship between the Development of Slip Surfaces and Small Scarps on Deep-Seated Catastrophic Landslides

YOKOYAMA, Osamu[1*] ; OGAWAUCHI, Yoshito[1] ; YAMAZAKI, Tsutomu[1] ; SAKURAI, Wataru[2] ; SAKAI, Ryo[2] ; OKUYAMA, Yuki[2] ; KITAGAKI, Hirofumi[2] ; HIRANO, Go[3]

[1]Japan Conservation Engineers & Co., Ltd., [2]Sediment Disaster Prevention Technology Center, Kinki Regional Development Bureau, MLIT, [3]Kii Mountain District Sabo Office, Kinki Regional Bureau, MLIT

To predict the occurrence of deep-seated catastrophic landslides in advance, it is effective to recognize the surface topography that has preceded the catastrophic landslide. Recently, it has become possible to obtain high-resolution DEMs using the airborne laser scanner survey (LiDAR). However, in areas where mountains have high relief and fractured sedimentary rocks, large-scale gravitational slope deformation proceeds in a wide area, while topography, such as linear depressions and uphill and downhill-facing scarps, becomes sufficiently developed. Thus, in just recognizing deformed topography, it is difficult to identify high risk catastrophic landslides. Therefore, it is necessary to determine the relationship between the internal geological structure and the geometry, and differentiate geomorphological features by standards to predict the location, scale, and occurrence time of catastrophic landslides. In this study, we clarify the geomorphological and geological features of a deep-seated catastrophic landslide (Akadani) that occurred on the Kii Mountain because of heavy rain in 2011. Additionally, we examined the relationship between the slip surface and the small scarp.

It is considered that the shear proceeds in the brittle fracture zone of a minor fault, and that the weak layer of the slip surface is formed in the creeping rock mass. Also, several meters of the small scarp were formed before the catastrophic landslide, and are consistent with the outline of the catastrophic landslide. In fact, the shear plane came out of the ground by concatenating minor faults that were located intermittently in the mass rock. In addition, large scale planar structures, such as a thrust or high-angle fault, controlled the outline of the catastrophic landslide. Kawarabi and Nagatono, adjacent to Akadani, also have many similar points that are made up of the same geomorphological and geological structures.

Keywords: deep-seated catastrophic landslide, slip surface, minor fault, gravitational slope deformation, small scarp, LiDAR