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Analysis of hydrological deep-seated landslides triggering mechanisms in Mt. Wanitsuka, Kyushu Island.

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In September 6th of 2005 Kyushu Island was hit by the typhoon No 14 causing several damages and large slope collapses, such as deep seated landslides and debris flows. Some of them took place in Mt Wanitsuka, Miyazaki Prefecture. This study has the objective to analyze the hydrological conditions which trigger deep-seated landslides in Mt. Wanitsuka. For that purpose it had been controlled three small catchments in the vicinity of a deep seated landslide scarp which took place in 2005, from 2008 until the present. In those catchments it was installed parshall flumes and water samplers to control runoff O18/Deuterium isotopic concentration and ionic concentration. Additionally in the area it was installed 2 boreholes, 40 m and 10 m depth, to control the groundwater level and one pluviometer. The geology of the mountain is mainly shale interbedded sandstone highly fractured. According to previous studies based on analysis of effective rainfall and groundwater level, the effective rainfall with a half life of 84 hours show the best correlation with the lag time between the peak of rainfall and groundwater level peak (Tanaka, 2010). Using that correlation it was possible to estimate the timing of landslides event in 2 min after the rainfall peak. That agrees with the estimation time of landslides occurrence which is 30 min. after the rainfall peak. In other hand, Takahashi (2010) analyzing the Ca²⁺ concentration of streams water in the same study area demonstrated the high correlation between the sites where deep seated landslides deposit are located and the influence of deep ground water. The isotopic analysis of runoff shows a significant pulse of "old water" during the rising limb of the runoff hydrograph. That pulse was observed for precipitation with regular intensity (30 mm/hr as a peak) and accumulated rainfall of about 200 mm (in 20 hours). For the next rainfall events with similar intensity but smaller duration (smaller accumulated rainfall) the pulse of "old water" progressively reduced. This evidence suggests the importance of the accumulated rainfall in the hydrogeological response of the catchments in the study area and therefore it has an important role in the triggering of deep seated landslides over the high intensity rainfall. That agrees with the characteristics of the trigger precipitation of the landslides in 2005, with about 40 mm/hr as a peak intensity but 900 mm of accumulated rainfall at the estimated time of landslides occurrence. For that reasons it is suggested that the analysis of deep seated landslides triggering mechanisms must consider a variable, based on the accumulated rainfall as the effective rainfall, which indicated of the volume of water stored in the bedrock trough the time in order to estimate the critical volume to trigger deep seated landslides in the area.

キーワード: Mt. Wanitsuka, Deep-seated landslides, Landslides triggering mechanisms, Kyushu, 2005

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