Post shear behavior of pyroclastic fall deposits and landsliding phenomena during the 1949 Imaichi earthquake

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Landsliding phenomena occurring on pyroclastic fall deposits during earthquake had been widely reported. Some of them are in small scale but very catastrophic due to their rapid post failure movement. For example, the Hanokidaira landslide triggered by the 2011 Tohoku earthquake had replaced the debris of about 100, 000 m^3 and killed 13 people. The 1949 the Imaichi earthquake with a magnitude of 6.4 had also triggered more than 80 landslides (Morimoto, 1951), resulting great damages to local properties and lives. However, the initiation and movement mechanism of such kind of catastrophic landslides had not been fully understood. In this study, we surveyed some typical landslides triggered by the 1949 Imaichi earthquake, and examined the geological features of these landslides. We also took samples from the field and kept them in natural moisture state by putting them in plastic bags. We sheared them in both natural moisture state and fully saturated state under undrained or natural drained condition. We did not dry the sample in all the tests to avoid the possible change in clay mineral (halloysite). Our test results showed that all these samples had their residual shear resistance lowering to a very small value with progress of shearing after failure, indicating that the landslide occurring on this kind of pyroclastic fall deposits can suffer from rapid movement. The lower permeability of the sample retarded the dissipation of high excess pore-water pressure generated with the shear zone and then would enable the long runout of the displaced materials. The initiation process of the samples also indicated that strong ground motion during the earthquake would be the prerequisite and the strong ground motion might have resulted from the nonlinear site response features of unsaturated soil layers.

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