

Landslides of pumice fall deposits induced by the 2009 Padang earthquake and the formation of halloysite

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The 2009 Padang earthquake triggered nearly 1000 landslides which killed at least 600 people, a half of the death toll of the Padang earthquake. We made field investigation and laboratory analyses in order to clarify the mechanism of these landslides.

We investigated Tandikat area where the most destructive landslides with long run out had occurred. Tandikat area is widely covered by pumice fall deposits, which hereafter referred to as the Qhpt, underlain by paleosol. We found that landslide sites have common characteristic features: 1) Landslides occurred in area with Qhpt thicker than 4 m, 2) Sliding surfaces were made in a layer of mixed pumice and paleosol at the base of Qhpt.

From XRD analysis, we find that the pumice-paleosol mixed layer is rich in halloysite, while the underlying paleosol is rich in gibbsite and almost free from halloysite. Upper part of the Qhpt which had not been mixed with paleosol is free from halloysite. Cone penetration tests in the field showed that the pumice-paleosol mixed layer has the smallest resistance.

These evidences suggest that the halloysite rich pumice-paleosol mixed layer was one of the most important geological factors of the earthquake-induced landslides in this area. Halloysite in the paleosol of the mixed layers was probably made by the interaction between gibbsite and dissolved silica from pumice grains in the mixed layers and from percolating groundwater. Halloysite formation in the pumice grains of the mixed layers likely was promoted by the water accumulated on the essentially impervious paleosol.

Keywords: halloysite, the 2009 Padang earthquake, landslide, pumice fall deposits, geohazardz, landslide induced by earthquake