

# Fluidized landslides triggered by the liquefaction of subsurface volcanic deposits during the 2018 Iburī–Tobu earthquake, Hokkaido

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The Iburī–Tobu earthquake of  $M_w = 6.7$  occurred at 3:07 AM (local time) on 6 September 2018, in southern Hokkaido, Japan. The earthquake caused power cuts and destroyed distribution networks across Hokkaido, creating widespread disruption. A total of 41 people were killed during the earthquake, with most of these (36 people) perishing in landslides near the epicenter. The hills in southwestern Hokkaido are widely covered by volcanic deposits, derived from the repeated eruptions of nearby volcanoes such as Tarumai, Eniwa, and Shikotsu (e.g., Nakagawa et al., 2018). On 4 September, Typhoon Jebi caused heavy rainfall in this area, which likely soaked and weakened the volcanic soils. Subsequent earthquake ground motion (with a maximum intensity of 7 on the intensity scale of Japan Meteorology Agency; Japan Meteorology Agency, 2018) may have triggered sudden whole-slope failures. The total number of the present landslides was ~6000 (Yamagishi and Yamazaki, 2018), and most of the recorded landslides are shallow and show features characteristic of fluidized landslides, such as long runouts of debris on a flat depositional area.

To investigate the mechanism generating the landslides triggered by the Iburī–Tobu earthquake, we conducted a field survey at a typical landslide in the Tomisato area of Atsuma, and we found a distinctive occurrence of liquefaction in the field, which could be a precursive condition for the generation of the fluidized landslides triggered by the earthquake. In the scarp of the landslide, an altered halloysite-bearing volcanic layer is observed at a level almost coincident with the sliding surface. The layer is intensely undulating and can be divided into an upper clay-rich layer and a lower pumice-rich layer, suggesting that the altered layer had liquefied as a result of the strong coseismic ground motion. The layer had been soaked by heavy rainfall just one day before the earthquake and could have liquefied by interstitial fluid pressurization, producing a weak and slippery plane, resulting in the catastrophic landslides in this area.

Keywords: fluidized landslide, 2018 Iburī–Tobu earthquake, halloysite