

EGU21-3570, updated on 28 Jan 2022

<https://doi.org/10.5194/egusphere-egu21-3570>

EGU General Assembly 2021

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Geological aspects of shallow landslides induced by the Heavy Rain Event of July 2018 within Late Cretaceous rhyolite, southern Hiroshima Prefecture, Japan

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Rain-induced landslides often occur in clusters on hillslopes that have unique geological characteristics, such as lithology, weathering patterns, and hydrothermal alteration. However, the effects of geological factors on landslides involving rhyolites are not fully understood. A heavy rain event during July 2018 caused numerous debris avalanches and debris flows within areas underlain by the Late Cretaceous Takada Rhyolites, southern Hiroshima Prefecture, Japan. To understand the geological factors that influence landslides in areas underlain by rhyolites, we performed GIS analyses and field investigations of outcrops and landslide scars. The study area is rectangular, 9 km long, and 3 km wide, and the long sides, oriented NE–SW in Kure City. The Norosan Welded Tuff, which forms the rhyolite unit in the study area, has near-vertical joints spaced 0.1–5.0 m, and a large number of high-angle veinlets that record hydrothermal alteration. The average joint spacing is 1.8 m in the SW of the study area (0–3.5 km), decreases from 1.8 to 0.4 m in the center (3.5–5.0 km), and 0.4 m in the NE of the study area (5.0–9.0 km). Tors are developed on the ground surface on hillslopes in the SW of the study area, but the NE of the study area is underlain by clay-rich altered soil without corestones. The 45 h and 4 h cumulative rainfall distributions prior to the landslide event were similar in the SW and NE parts of the study area. Furthermore, the NE and SW parts of the study area have a comparable proportion of surface area with similar topographic parameters (slope, planar curvature, and catchment area) to those of landslide scars. In spite of these similarities, the landslide density is about ten times higher in the NE of the study area (10–55 /km²), than in the SW. This difference is attributed to differences in joint density, and the intense weathering and alteration on joints within the rhyolite.