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Temporal and spatial distribution of the sediment rates of the infilling into an old landslide scar, central Japan

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Both the trigger (i.e., rainfall and earthquakes) and the predisposition (i.e., development of soil mantles with low shear strength) are needed for initiation of landslides that sometimes cause severe sediment disasters. Therefore, understanding the rates of sediment infilling into old landslide scars is needed for prediction of the reoccurrence of landslides. Rate of sediment infilling (e.g., soil creep, dry ravel) varies in time and space affected by the climate and the hillslope topography. However, field data related to spatial and temporal changes in the sediment rate of infilling is scarce. Thus, we observed the sediment infilling in and around the Kumanodaira landslide, central Japan, using strain probes, sediment traps, and surveying instruments. The Kumanodaira landslide, which was elongated several times after the initial failure in 1910, killed fifty people during a heavy rainfall event in 1950. We also investigated temperature (air and ground temperature) and precipitation at the landslide to clarify factors affecting types and rates of the sediment infilling. Our five-year observations revealed that both chronic and episodic infillings occur in and around the landslide scar. Both the velociy of piles installed on the slope surface and the volume of sediment captured by sediment traps correlate with number of times that the air temperature up and down zero degree. Therefore, soil creep and dry ravel caused by the freeze-thaw in winter are the predominant chronic infilling in the Kumanodaira landslide. Observation by the strain probes revealed that these chronic possesses are active in the shallower soil layer (depth < 60 cm) in which periglacial processes are active. Meanwhile, episodic small slope failures and debris flows during heavy rainfall events also supply (and sometimes evacuate) sediment. Geomorphic analysis using 1-m resolution DTM showed that spatial distribution of the sediment rate in the landslide scar has a strong correlation with the slope gradient. This result corresponds to observation results reported in prior studies. In contrast, sediment rate outside of the landslide scar is highly affected by the location relative to the scar. Soil creep is active around upper slope of the head scar, while sediment is stable around lateral ridge of the landslide. Relationship between slope gradient and sediment rate was poor outside of landslide. Our study implies that longitudinal profile of the slope, including relative location to the landslide scar, as well as climate factors (i.e., temperature and rainfall) are important to consider temporal and spatial distribution of the sediment rate of infilling processes in and around landslides.