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Difference in surface-stone dislocation by ground cover on wind-beaten slopes in temperate low mountains in winter

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Hillslopes below the tree line, which is usually protected from frost action with vegetation cover, are subjected to seasonal periglacial mass-movements when vegetation is removed by, e.g., strong wind and/or human activity. Among various factors which may control the occurrence of such azonal periglacial processes on wind-beaten slopes in temperate low mountains, we took notice of ground-surface condition.

There is wind-beaten bare ground near the Goreibitsu pass in northeastern Japan forest zone (c. 900m a.s.l., 37.5N) . While mean annual air temperature is 7.3 degree, air temperature in winter reaches about -10 degree on the bare ground. This bare ground is composed of four layers/horizons; I: Angular flat stones with no matrix; IIA:Very dark brown humic clay loam(Sand 8.9%, Silt 78.5%, Clay 12.5%)with few angular stones;IIAB: Dark brown clay-loam to loam (Sand 1.1%, Silt 79.3%, Clay 19.6%) with common angular stones;IIC: Dull brown to dull orange brown loam (Sand 9.7%, Silt 76.2%, Clay 14.0%) with many angular stones. IIA remains only under vegetation around the bare ground.

We observed air temperature, ground surface temperature, ground temperature and dislocation of surface stones (Layer I) in four winter seasons from 2006-07 to 2009-10. Dislocation of surface stones was observed by changes of the nine painted lines. Length and dominant angle of these lines are 8.3-25.3m and 6-20 degrees respectively.

Ground-surface condition is divided into the following two types: one is the C type, which is covered with thick Layer I, and the other is the F type, where small stones scattered on almost exposed IIAB. We applied the division to the record of surface-stone dislocation in 2007-08 winter.

Records of ground temperature show that freezing and thawing repeated only in the upper part of IIAB horizon at several, not all, points. Mean values of stone dislocation in a winter on C type and F type ground surface were 0.35m and 0.52m, respectively. It is obvious that a bigger dislocation occurred on F type ground surface than on C type one.

The difference is considered the consequence of more intense and frequent occurrence of freezing and thawing on F type ground surface where IIAB almost exposes than on C type one where IIAB is continuously overlain with stones (Layer I). On both types of ground, freezing and thawing which are the major driving force of surface stone dislocation occur in the upper part of IIAB. Differential occurrence of surface stone movement is thus considered the results of differential response of fine earth layer with or without stony cover to freezing temperature. It seems one of the characteristics of periglacial mass-movements on slopes in temperate low mountains.

Keywords: Solifluction, Surface materials, Low altitude mountain slopes