

Feature of landslide of pyroclastic fall deposits induced by 2018 Hokkaido Eastern Iburi Earthquake, and its relation with damage

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Many landslides occurred by the 2018 Hokkaido Eastern Iburi Earthquake around Atsuma-cho. Rapid landslide consisting of Holocene pyroclastic fall deposit (Debris slide by the classification of Varnes, 1978) gave the human damage of 36 above all. We show the topographical and geological cause and morphological characteristic of the landslides and discuss about relations with the human damage.

Tephra mainly derived from Shikotsu, Eniwa and Tarumai volcanos cover on sedimentary rocks for Neogene of the base in Atsuma area. Among these tephra, the Tarumai d pyroclastic fall deposit (Ta-d: 9ka) thickly distributes in this area as a central axis of distribution. Ta-d (thickness 1-2m), the tephra (Ta-c,-b,-a) and black soil (total thickness approximately 1.5-3m) which did mantle bedding was translationally sliding as landslide body. The sliding layer was formed in several centimeters above from the base of the Ta-d pumice at the slope where Ta-d directly covered the mudstone and mudstone rubble. The thickness of the layer was 1-3cm and is made of creamy clay including the halloysite. In addition, the sliding layer was formed in the weathered volcanic soil including pumice derived from Eniwa a and Shikotsu 1 Tephra in the area where the Ta-d covers up the volcanic soil.

The landslides in Atsuma area into following 7 types based from form and another feature of the slide, i.e. 1) Type Gv: Extremely gentle, shallow valley form, 2) Type Sv: Gently shallow valley form. 3) Type Dv: Deep valley form with alluvial cone or landslip lobe 4) Type Hv: Hanging valley form, 5) Type Ps: Planer slope, 6) Type Cf: Complex of Some valley form collapses along the small stream, and 7) type Ol: Gently landslide caused by overlapping of other slides.

Although there is difference in some clarity, the cutting of the layered bedding of Ta-d is often seen at the slope end in these slopes. The valley wall slope that Ta-d covers is eroded by small stream in the Type Cf. Because the thinning and omission of Ta-d occur at an exit of the hanging valley in the Type Hv, it is in a near condition for "lower part cutting". In addition, the convex break of slope angle and a man-made small cut is often observed in the foot of the collapse scarp with the Types Sv, Dv and Ps.

The landslide body of each type was moved with mostly maintaining of bedding form from the source area to the depositional area. The terminal form of slides has many variations, i.e. from stacking of plural sliding bodies which make thrust on the front, to separating and crushed into many blocks. Fluidized slide material such as the Type Cf made depositional lobes like a debris-avalanche or a debris-flow deposit in the terminal area. The distance from the base of slope to the tip of the sliding body of Types Cf, Hv and Dv were generally longer than the type Ps. The thickness of landslide body was about 1.5-3m which was reflected from the total thickness of stratified Ta-d and other tephra and black soil, and reaches 3-5m in the part which some bodies stacked at the terminal. The damaged buildings were located at the mouth of small stream and were located in the accumulation area of the landslides. Height of the first floor of the house is almost about 3m.

The geological cause of landslide is that The Ta-d tephra distributes widely with the mantle bedding. The pumice of Ta-d is weathered and halloysite formed in it. Furthermore, the tephra was cutting in the foot of slope in many places by natural and artificial process. On the other hand, the Eastern Ebury Earthquake showed that a landslide will occur by all means in the sloping ground including extremely gentle area that pyroclastic fall deposit cover with mantle bedding when the large-scale inland earthquake occurs. Because it is impossible to predict earthquake, inhabitants of the slope area cannot evacuate beforehand. The preventive measures construction is not necessarily realistic. It is necessary to avoid building house at the mouth of small valley and to make a bedroom in the places more than second floor for reducing human damage.

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