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## Structure of the rock failure toe slid on the snow surface induced by the Northern Nagano Prefecture Earthquake

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Many landslides and snow avalanches were occurred around the boundary between Nagano and Niigata Prefectures induced by the Northern Nagano Prefecture Earthquake (M 6.6) on March 12, 2011. Structure of the rock failure toe occurred at Tatsunokuchi, Tsunan Town, Niigata Prefecture is described here. The failure has the long runoff, which is a type of landslide to take care in the snow covered area.

The failure occurred right below at the western ridge of Mt. Eboshigatayama. The dimensions of about 100 m wide and 10 to 20 thousand cubic meters in volume are estimated from aerial photograph interpretation. The failure mass flowed down 700 m and buried Funetsunagigawa River and Route 353. The apparent friction angle is 20 degree, that indicates the fluidity of the mass was high.

Most sections of the toe show the stratigraphy of in situ snow cover, snow debris by the full-depth snow avalanche, and rock debris in ascending order. The snow debris including small amount of sandy or cohesive soil derived from cultivation has no snowfall structure, is brecciated, and is hardened. Rock debris including little amount of snow blocks is mainly composed of weathered mudstone in the lower or outer part, and of sandstone in the upper or inner part.

Such observation indicates that the moving mass was not simply formed by the mixture of the snow cover and rocks. It is likely that the full-depth snow avalanche involving surface soil and vegetation occurred before the rock failure. The following rock mass probably slid on the snow surface. High fluidity of the moving mass can be explained by this mechanism.

Keywords: rock failure, snow avalanche, Northern Nagano Prefecture Earthquake, Tsunan Town