

Prediction and stability evaluation of potential sites of deep-seated catastrophic landslide

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Chigira (2009) and Chigira et al. (2013) analyzed geological structures and topographic features of deep-seated catastrophic landslides induced by rainstorms in accretion complexes of the southwest outer belt of Japan, and found that those landslides had been preceded by gravitational slope deformation typified by small scarps along their future crowns, which could be a clue to predict potential sites of catastrophic deep-seated landslide. This paper summarizes the methodology of potential site prediction and stability evaluation of catastrophic landslides, including stratified rocks in addition to broken beds and mixed rocks in accretion complexes.

In order to extract potential sites of catastrophic landslide, we need to judge whether deep-seated gravitational slope deformation may develop to catastrophic failure or not, considering possible structures of gravitational slope deformation on a certain geologic background. We examined the relationships among morphological expression of gravitational slope deformation, geologic body, geological structure, and deformation mechanisms, then took account of upslope and downslope conditions, and finally tried to evaluate the probability of catastrophic failure with the help of our experience of previous catastrophic landslides.

Irregularly shaped bumpy slope:

This is typically made when incipient sliding zones are being made in a rock body with complex discontinuities like broken beds or mixed rocks. Only this topography does not suggest the high probability of catastrophic failure, but additional eye-brow shaped small scarps and failures in the lower part of a slope may suggest high probability.

Linear depressions and wrinkles:

Symmetric alignment of linear depressions on both sides of a ridge suggests lateral spreading with the settlement of the ridge top, which does not likely develop to catastrophic failure.

Linear depressions and wrinkles developed on one side of a ridge are made flexural toppling of steeply dipping foliations of bedding or cleavage. This type is self-stabilizing deformation, but when downslope-facing eye-brow scarps are made and lower part of the slope is failed, catastrophic failure likely occur. Ridge-top depressions, when connected to steps and to a hollow on the side margin of a deformed area, catastrophic failure also likely occur.

Large head scarps or ridge top depressions:

These topographies on an under-dip cataclinal slope suggest buckling deformation, which may be stable when a competent rock layer exists or deformation extent is less, but when the deformation progresses further and lower slope is failed, the probability of catastrophic failure becomes high.

Large head scarps or ridge top depressions on an over-dip cataclinal slope suggest sliding in a strict sense with mature and continuous sliding zones. Such a landslide may continue slow movement without catastrophic failure, but when the foot is cut by failure, it may develop to catastrophic failure.

References

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