

The response of a rockslide to water infiltration: monitoring rapid movement in the head area of the Aresawa rockslide

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This study evaluates the response of a rockslide to water infiltration in the head area of the Aresawa rockslide (ca. 3000 m a.s.l.), Akaishi Range, where a partial collapse occurred in May 2004. Surface displacements were monitored by geodetic surveys performed 20 times from October 2006 to August 2009. Concurrently, meteorological parameters (air and ground surface temperatures, precipitation and snow depth) were recorded with data loggers. The head area moved at an average rate of 60 cm yr⁻¹ as a result of bidirectional movements on a single slip plane (N30-40E, 50-60S) below a distinct downhill-facing scarp (sackung feature). Bidirectional movements consisted of (1) dip-slip, which moves toward the dip direction on the slip plane, and (2) side-slip, which moves oblique to the slip plane. The major trigger switching between the two modes is considered to be the groundwater regime. Snow cover and the underlying frozen ground prevent water infiltration in winter months, inducing the lack of liquid water in the bedrock. This condition leads to the predominance of slow dip-slip at a rate of 1 mm day⁻¹ or lower, which represents gravitational rock slope deformation. In contrast, snowmelt water and rainfall in summer and autumn promote water infiltration into the bedrock, which significantly destabilizes the rock slope. In these periods, the unstable slope shows side-slip at a rate of up to 10 mm day⁻¹ toward the debuttressing slope produced by the 2004 collapse. Such shifting movements may be produced by a blocking effect at the toe of a slipping rock slab and may further destabilize the rock slab. These results suggest that an incipient slip plane below the sackung feature grows into a well-defined smooth slip plane toward a collapse.

Keywords: rockslides, sackung, geodetic survey, seasonal frost, Akaishi Range