

Reconstructing large-scale mass movements using terrestrial cosmogenic nuclides: applicability and limitations of various approaches

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This study reviews methodology and applications of terrestrial cosmogenic nuclide analysis for revealing timing and processes of large-scale gravitational deformation and/or deep-seated bedrock landslides in high-relief hillslopes. Use of exposure dating for non-tectonic scarplets, exposed sliding surface, and landslide deposits enable us to determine ages and sequences of such mass movements. However, in many cases, we cannot calculate ages based on a single-exposure scenario because of pre-exposure cosmic-ray irradiation history and/or post-exposure denudation. Appropriate reconstruction of timing and processes of the events requires cross-checking by multiple data and adequate modeling for nuclide production and accumulation with a presumable model for geomorphic processes. Simulation and actual examples of nuclide concentration will be demonstrated in this lecture. In an overview for a wider range of mountainous terrain or watersheds, age data for several signatures as well as depth-profiling of nuclide concentration in boring cores extracted from multiple sites provide information of spatiotemporal frequency of such large-scale mass movements in the region of interest. Current applications and concept will be presented for leading a future research vision.

Keywords: gravitational hillslope deformation, deep-seated bedrock landslide, exposure dating, geomorphic process modeling