River incision, climate change, and bedrock landslides in a high-relief mountainous landscape in Japanese Alps

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The present study attempts to reveal role of long-term river incision and climate change in triggering deep-seated bedrock landslides and thus shaping high-relief mountainous landscapes in a tectonically active region. We curried out GIS(Geographic Information Systems)-based analysis of a 10 m mesh DEM (Digital Elevation Model) and dating of paleo bedrock landslides using TCN (Terrestrial Cosmogenic Nuclide) in Japanese Alps. The topographic analysis revealed long-sectional shape of hillslopes, which is statistically steeper at lowest parts reflecting active undercutting by river incision. The spatial distribution of hillslope angles accords with the output of a simple stability model for bedrock landsliding with a set of parameters of weak rock-mass shear strength. This results imply that river incision and bedrock landslides maintain a quasi-dynamic-equilibrium state of topography with accompanying slope break on hillslopes. Samples for exposure dating were collected from top of boulders on landslide deposits or bare rock slip surfaces. Effect of snow shielding on nuclide production were corrected, and calibrated by radiocarbon dating for some deposits yielded by the identical landslide event. The ages of landslide deposits concentrated in Holocene especially at just after the transition from the last glacial to present interglacial era, and also recent period during the last 3 kyr. These results imply that climate change has potentially instigated the occurrence of bedrock landslides and thus contributed to form and maintain bedrock dominated topography in high-relief mountainous ranges with steep hillslopes adjacent to incised valleys.

Keywords: deep-seated bedrock landslide, slope break, terrestrial cosmogenic nuclide, glacial-interglacial cycles, quasi-dynamic-equilibrium

