Estimating the paleo-earthquake characteristics in a stabilized accretionary wedge based on the geological record: evidence of co-seismic landslide?

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Abstract

The Outer Western Carpathians constitute an accretionary wedge within the Alpine-Himalayan orogenic zone in central Europe. In this region, Mesozoic and Cenozoic sedimentary (flysch) rocks underwent deformation and were thrust over the European foreland during the Paleogene and Neogene. The hilly to mountainous terrain has been significantly impacted by various types of shallow slides, debris flows, and deep-seated slope failures of varying magnitudes. Due to the absence of direct evidence of intense seismicity and information on present-day tectonic activity, these landslides have traditionally been attributed to permafrost thawing around the Pleistocene transition and triggered by intense rainfall. However, recent field investigations in the region have revealed active polyphase strike-slip surface ruptures, raising questions about the origin of paleo-landslides and their implications for paleo-earthquakes in the area. Furthermore, it is imperative to comprehensively distinguish the typical features of earthquake-induced landslides from rain-fall-triggered landslides. This study employs a combination of site investigations, experiments, and future numerical simulations to address and clarify these questions. Preliminary results indicate that the depleted landslide morphology and toppling, commonly associated with seismic events, align with fault geometry and lacustrine deposits in the surrounding area. The rotary-shear test has been employed to determine the peak and steady-stage friction coefficients of the rock formation, approximately 0.75 and 0.05-0.2, respectively. These parameters are crucial for controlling future simulations of landslides under seismic assumptions using PFC3D.

Keyword: Outer Western Carpathians, Paleo-earthquake, Co-seismic landslide, Rotary- shear test, Numerical simulation PFC3D.