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Contribution to understanding historical evolution of rockfalls and landslides slopes using dendrochronological methods: example from the Kamienne Mts, Sudetes, SW Poland

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In the area of Kamienne Mts (Central Sudetes), within the volcanic bedrock of Permian age, vast landslide slopes have developed. Their relief is often complex and include main scarps at different stages of degradation and landslide tongues, accompanied by rock walls, scree slopes and debris cones. Absolute ages of these landslides remain unconstrained. We have analyzed three landslide slopes in the highest parts of the Kamienne Mts. Study sites are characterized by different features of relief, which indicate their diverse relative age. Using dendrochronological tools (dating tree-ring eccentricity, compression wood, scars and resin ducts) we have estimated the level of contemporary activity of these landforms. Relief of the slope of Mt Turzyna (895 m a.s.l.) suggests that the site represents a landslide at an early stage of development – with an initial scarp, fresh slope trench and steep landslide tongue. Using dendrochronological tools we have confirmed ongoing slope instability in the area. It occurs with average frequency of 2 events per decade during the last 50 years. Within a study site located on the slope of Mt Suchawa (928 m a.s.l.) a vast landslide main scarp exists, partially with rock face sections. Rock walls are subject to rock fall. Between the head scarp and a landslide body of complex morphology and step-like profile scree slope and a debris cone exist. Dendrogeomorphic analysis shows that activation of landslide slope occurs 1-2 times every 10 years (avg. from the last 90 years). Studies have also confirmed the contemporary activity of rock falls (avg. frequency: 1/10 years) and creep of debris within the cone (avg. frequency: 1-2/10 years during the last 40 years). Within the site located on the slope of Mt Włostowa (903 m a.s.l.) a rock wall exist accompanied by scree slope and forested debris cone. Below the cone clear features of landslide relief are observed. Using dendrochronological tools we have found that the main contemporary geomorphic process at this site is rock fall (avg. frequency: 1-2 events/10 years during the last 40 years). We have also confirmed present activity of creep on the scree slope (1-2/10 years on avg. during the last 40 years). The landslide slope at the Włostowa site shows a distinctly lower activity than the other two sites. Analysis of relief and dendrochronological studies indicate that these slopes represent different stages of landform evolution. The youngest stage is represented by the Turzyna site, intermediate stage by the Suchawa site, and the most advanced one by the Włostowa site. Results indicate that the evolution of landslide relief in the region begins from initial landforms with simple relief which later turn into landslides of complex structure and relief. In late stages the rock head scarp is actively remodelled by rock fall. Consequently, a scree slope develops and partly buries the proximal part of the landslide body.