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How can we detect relict landslides? – and are they really relict? Lessons from Garbatka landslide terrain, Sudetes, SW Poland

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Landslide hazard for the Sudetes mountain range, Poland/Czech Republic, is generally estimated as low. Only a few historic landslides of larger dimensions have been recorded, usually triggered by heavy rain on river undercut hillslopes. However, recent geomorphic research indicates that in many localities within the Sudetes relict landslides of poorly specified age occur. The largest concentration of relict forms occurs in the Kamienne Mountains, in the Middle Sudetes. They have been recognized using field mapping that identified degraded head scarps, tongue-like depositional bodies within valley floors, steepened toes, and large allochthonous boulders on low gradient terrain, far from source. One such an apparently relict landslide fills the small valley below Mt Garbatka (792 m), near the village of Sokołowsko. It is approximately 1 km long and 200-300 m wide, while its flattened surface morphology and the occurrence of large dispersed boulders in the distal part suggests a flow-like movement. Geomorphic signatures of landsliding are subdued, suggesting that considerable time has elapsed since the origin of the landslide. This is consistent with the results of an extensive soil survey within the landslide body and on surrounding slopes. Similarity of soil properties and well-developed horizonation of profiles both within the landslide and outside it show that no major disturbance has taken place during soil formation, i.e. during the Holocene. This would suggest pre-Holocene age of the landslide. However, dendrogeomorphological research yielded evidence of numerous growth disturbances recorded in tree rings of Norway spruce growing on the landslide body. Some trees are tilted, mostly upslope. Former studies have revealed that this is a symptom of contemporary ground movements. The analysis of tree-ring eccentricity allowed us to determine the frequency of disturbance events (avg. 1 per 10 years during the last 70 years). These signals are interpreted that the slope surface is not stable under current environmental conditions, although slow creep-like movement rather than any faster movement would be consistent with geomorphic evidence. Dendrochronological results suggest also that mass movements are activated abruptly and also are abruptly suppressed. Thus, the displacements registered by tree rings appear episodic and are probably connected with large precipitation events, when creeping may affect the landslide body (e.g. 1977, 1997). Landslide hazard in the valley below Mt Garbatka appears low at present but to claim complete stability would be premature. However, the most important lesson from the case is that valleys in the Kamienne Mountains are not shaped solely by fluvial processes. Landslides have occurred here too, may be subject to reactivation, while valleys without clear evidence of past landsliding may be particularly prone to host landslides in the future.