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Using soil properties as a tool to differentiate landslide generations and constrain their ages – Rogowiec landslide, Sudetes (SW Poland)

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The Sudetes, at the border of Poland and the Czech Republic, are generally considered as a mountain range where landslides play a marginal geomorphic role. Only a few larger landslides have been recorded during historical times, mainly on steep valley sides undercut by rivers. Forested slopes, which dominate in the Sudetes, are usually inferred to be stable, except for near-surface bioturbation and localized accelerated surface erosion at sites subject to strong human impact. Large, apparently relict landslides in the Kamienne Mountains, Middle Sudetes, pose a considerable challenge to this view and two interpretations are possible. First, they may be indeed relict, pre-Holocene features that formed under different environmental conditions and have been completely stabilized since the origin. Second, they may be rare components of the contemporary (Holocene) geomorphic system but their frequency of occurrence is low and this is why none has been reported in written or oral records. If the second scenario captures the reality adequately, this would have significant implications for hazard and risk assessment.
To address this issue, an extensive soil survey was carried out on the large landslide of Rogowiec, likely of complex flow nature as suggested by landform mapping. The rationale of the study involved an assumption that soil formation time in the area is limited to the Holocene, since harsh periglacial conditions typified the late Pleistocene. 15 soil pits were excavated within landslide terrain and on adjacent reference slopes which do not bear any evident traces of significant displacements. Despite the small area under investigation, the soil profiles are very diverse in terms of depth, horizonation, organic matter content, development of soil structure, as well as the content and lithology of coarse fragments. A great deal of this diversity can be explained by different duration of pedogenesis controlled by geomorphic processes. Very weakly developed soil profiles in the landslide body do not show evidence of protracted soil evolution under contemporary climate and hence, are interpreted as having been formed during a fraction of the Holocene. This implies a Holocene age of the landslide. In addition, an older shallow translational landslide has been recognized on the valley side, with the toe buried by the main Rogowiec landslide. The depletion area was identified through the occurrence of thin, truncated soils (compared to the neighbouring slopes). This and the occurrence of weakly horizonated and poorly structural soils in the landslide body itself suggest that this valley-side landslide is of the Holocene age too. Thus, soils proved a powerful tool to establish the relative chronology of landslides and give strong evidence of their Holocene age. Soil research is recommended as a part of landslide hazard and risk assessment for landslides of unknown age.