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The impact of tectonic and structural parameters in Triassic bedrocks on the landslide susceptibility in Quaternary surface formations

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Important controlling factors of mass movements are soil water and geometric-topographic terrain factors such as inclination, curvature type and degree or the relative position of instable slopes and embankments. In addition various geologic parameters, that have a direct or indirect connection to the soil-mechanical properties of the slide masses, are of importance. Among others, these are the age (degree of consolidation), the granulometric composition (e.g. clay content, cohesiveness) and the permeability of the loose rock. However, the importance of these parameters is strongly dependent upon the specific geo-factors of the investigated regions.

Few studies also emphasise tectonic parameters, such as the bedding dip, in the context to the susceptibility of mass movements. Hereby, the 'apparent dip' plays an essential role for the slope stability, i.e. the dip angle of the bedding in the slope direction. However, these contributions focus largely on the susceptibility to sliding within the layers. In contrast, the aim of the present study is to identify the importance of the stratigraphic sequence for mass movements in the surface formations on top of the bedrock.

The research area is part of the southern Solling anticline, a saddle structure in the Middle Bunter Sandstone formation in Northern Hesse and Southern Lower Saxony (Germany). The Fulda, Werra and Weser rivers have cut 200 - 300 m deep into the anticline formation. The sandstone, clay, and siltstone layers are interbedded with thin

layers of impermeable sand-, clay-, and siltstone. The strata series are predominantly flat bedded and generally dip with low values from the anticlinal axis. However, tectonic events in the course of the uplifting of the Solling anticline resulted in a partially intensive dissection of the Bunter Sandstone plateau into separate blocks with disrupted, tilted, and partially rotated layers. The uplifting reached amounts of 100-120 m in the course of the Tertiary, 50-100 m during the Quaternary, and is actually ongoing.

The structural conditions have an indirect impact upon landslides in the superposed Tertiary, yet mainly Quaternary surface formations. This is a result of intermittent flow of stratum and joint water and causes a spatially limited and of varying intensity wetting of the surface formations. The effect occurs particularly in the water impermeable layers of the interbedded series. The investigations show that mass movements are often linked to the sites of outcrop springs and especially occur after long periods of rainfall. It can be assumed that there is a connection between the ratio ‘dip direction - slope exposure’ und the spatial distribution of mass movements.

In a GIS-based analysis, the factor ‘stratigraphic sequence’, in comparison to further controlling factors, is statistically evaluated and weighted and included in an empiric-statistical model for spatial description of hazard potentials due to mass movements. In the investigated region, in addition to the factors slope inclination and various curvature parameters, angle difference is of utmost importance for the spatial distribution of hazards.

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