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MASS MOVEMENTS AT THE BORDER BETWEEN THE NORTH-WESTERN TAUERN WINDOW AND THE LOWER AUSTROALPINE UNIT CASE STUDIES OF GEOTECTONICALLY INDUCED MASS MOVEMENTS

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Introduction

Slope instabilities in the north-western frame of the Tauern Window (Austria) in several locations have damaged infrastructural facilities. Extensive investigations were subsequently conducted to determine the reasons for these recent mass movements. A survey was carried out which not only included geomorphologic analyses, but which furthermore – based upon a structured standard legend (SCHEIKL et al. 2001) – looked into hydrologic/hydrogeologic, petrologic, lithologic aspects especially focusing on tectonic and geotechnic conditions. Features such as the current situation of slope water and the system condition of water courses were explored, and a correlation between the locations of recent slope failure patterns and nappe-tectonic boundaries, including associated faults and resulting geotechnical rock properties was found.

Methods

For the investigation, diverse methods were applied. In a first step stereographic infrared pictures taken by an airplane-based system were used to document slope failure structures of overriding importance. In a next step, extensive fieldwork was done to produce detailed maps, which were post-processed by means of a special CAD-based standard legend, developed for geomorphologic investigations. For each specific situation, maps which thematically combine morphologic, hydrologic, hydrogeologic, petrologic, lithologic and tectonic data were elaborated. Lithostructural data were processed and visualized using the "Tectonics FP" computer program. Additional 3D-visualisations of the mass movement system including all collected data helped to understand the complex situation.

Case studies

The area under investigation lies at the north-western edge of the Tauern Window between the Glockner Nappe and the Lower Austroalpine unit. The Glockner Nappe is thought to be a continuation of the Penninic unit of the Western Alps. In the course of the Tauern Window uplift and associated erosion processes, the Tauern Core complex was exhumed. The rocks of the Tauern window were subject to both ductile (deformation at high differential stress in combination with high ambient pressure) and brittle deformation (NEUBAUER et al. 2000). The deformation process as a whole produced large-scale structures such as dipping folds as well as small-scale structures occurring as isoclinal small folds and micro folds. Microscopic analyses revealed the presence of recrystallisation and crenulation fabrics.

The large-scale structures, which developed in the course of the multi-phase deformation history, are overprinted recent mass movements, which are reflected by prominent sagging structures and crack zones. These processes occur in the form of active hard and soft rock creep bod-

ies, which endanger inhabited and agricultural areas as well as infrastructural facilities (roads, power supply lines, and water pipelines). Analyses of the large-scale tectonic and morphologic structures revealed that the main slope failure zones in the area of the Stinkbach-Lackenbach system (Gerlos valley, Austria) largely correlate with the location of the tectonic boundary between the Glockner Nappe and the Lower Austroalpine unit. The pronounced opening of cracks leads to surface water infiltration, which significantly influences the slope water situation and consequently reduces the slope stability. An impact on the slope or mountain water condition by a nearby, shut-down and structurally weakened water pipe may also not be ruled out.

Another example of a recent mass movement in a comparable area at the north-western edge of the Tauern Window is in the Gerlos valley (Austria), near the "Ötschenwirt" (B165 federal road).

Apart from large-scale tectonic structures, this mass movement is characterized by quaternary sediments, as well as by a sequence of carbonatic middle triassic rocks overlying rocks of the Wustkogelserie and rocks of the Bündnerschieferserie, arranged in a system of hard rocks topping soft rocks known as "System Hart auf Weich" (R. POISEL & W. EPPENSTEINER, 1989).

Following the border between the Penninic Nappe and the Lower Austroalpine unit, the Navis valley is reached. The slope below the "Miesljoch" and the "Mieslkopf" is also subject to current processes of mass movements, endangering a residential area.

Even if the geotectonic situation in this area appears to be far more complex than in the Gerlos valley, the general situation may still be compared from the mass movement and general tectonics point of view.

Summary

In the vicinity of large-scale tectonic structures along the border between the Penninic Nappe and the Lower Austroalpine unit at the north-western Tauern Window, several mass movements have been observed. A thorough analysis of local scenarios clearly illustrates the close correlation between tectonic boundaries and slope instabilities. Large-scale tectonic structures go hand in hand with rocks exhibiting critical geomechanical properties. Micro-scale and macro-scale anisotropies in combination with adverse factors in the given geotectonic setting encourage slope instabilities.

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