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DEEP SEATED GRAVITATIONAL SLOPE DEFORMATION IN CONTEXT TO THE EXTERNAL FAULT PATTERN: THE GRADENBACH LANDSLIDE (SOUTHEASTERN TAUERN WINDOW, EASTERN ALPS)

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In alpine mountaineous regions, recent glaciation and tectonic uplift constitute areas of high relief and oversteepened slopes. These high energy environments often induce widespread mass movements, as we keep track of in the Gradenbach landslide (central Eastern Alps of Austria), a deep seated landslide with an extend about two square kilometers.
The Gradenbach landslide represents a sackung type slope deformation and shows large scale gravitional deformation. During the last three years, a GPS-monitoring system has surveyed this landslide. The measurements indicate a continouous speed up since 1999 and movement peaks about 10 and 20 cm per month in periods of heavy rainfall.
Geologically, the Gradenbach landslide is situated within the Matrei Zone, the uppermost Penninic unit within the Tauern Window. Structurally, the area of investigation is characterised by a penetrative foliation dipping towards the W to SW. This penetrative foliation is crosscut by several sets of semibrittle to brittle faults, trending N, ESE, and WNW. The major set is formed by the N- trending fault system, oriented parallel to the Möll Valley in this area. These faults show right-lateral displacement of several meters, with a cumulative displacement of approximately 5 km. These faults were re-activated as high-angle normal faults with E- and W- directed displacement. Additionally, W- to WSW- dipping foliation planes were activated as coeval low-angle normal faults. The major faults are characterised by the formation of cataclasites and non-cohesive fault gouges with a thickness of up to 10 metres. The WNW- trending faults show left-lateral displacement and are partly traced by some minor valleys, e.g., the Gradenbach Valley. These two sets of faults are cut by ESE- trending fractures showing minor displacement.

Morphologically, the ridge above the landslide appears as an E-W- trending crest. However, the head scarp is oriented oblique to the ridge, parallel to an ESE-WNW trending fault system. Also the lateral boundaries of the landslide are built up by distinct faults, oriented parallel to major fault system, traced by the N-S- trending Möll Valley.
To draw an comparison, similar areas in the surrounding show a higher morphological relief, a deeper downhill slope, but no mass movement. In these areas, the distinct fault systems do not penetrate the rock mass.
As a preliminary result, we can postulate, that the Gradenbach slope is not only controlled by the slope parallel gravity component, but by the combination of different fault patterns as well. Presumably, the landslide was not triggered by the activity of the major faults, but dominantely by fluvial erosion (Gradenbach) at the bottom of the slope. However, the occurrence of pre-existing discontinuities was essential for the initiation of slope deformation and controls its geometry. In particular, fragmented rocks and clayey fault gouge material enhance the intensity of infiltration, deposit, matrix flow and saturated run-off. This may result in an acceleration of the sliding process as well, also promoted by the orientation of the adjacent fault surfaces.