Großglockner Hochalpenstraße – Möll Valley

(Jürgen M. Reitner & Michael Lotter)

Coordinates: UTM WGS84 33N E 334150, N 5221650 (Hexenküche, location 1 in Fig. 1a)
E 341440, N 5195890, (Kräuterwiesen, location 9 in Fig. 1a)
Site, county: Village of Fusch, province of Salzburg; villages of Heiligenblut and Großkirchheim, province of Carinthia
Type of the slope failure: Different types of deep-seated gravitational slope deformations (DGSD)
Specific area: Valley of Fuscher Ache, Möll Valley

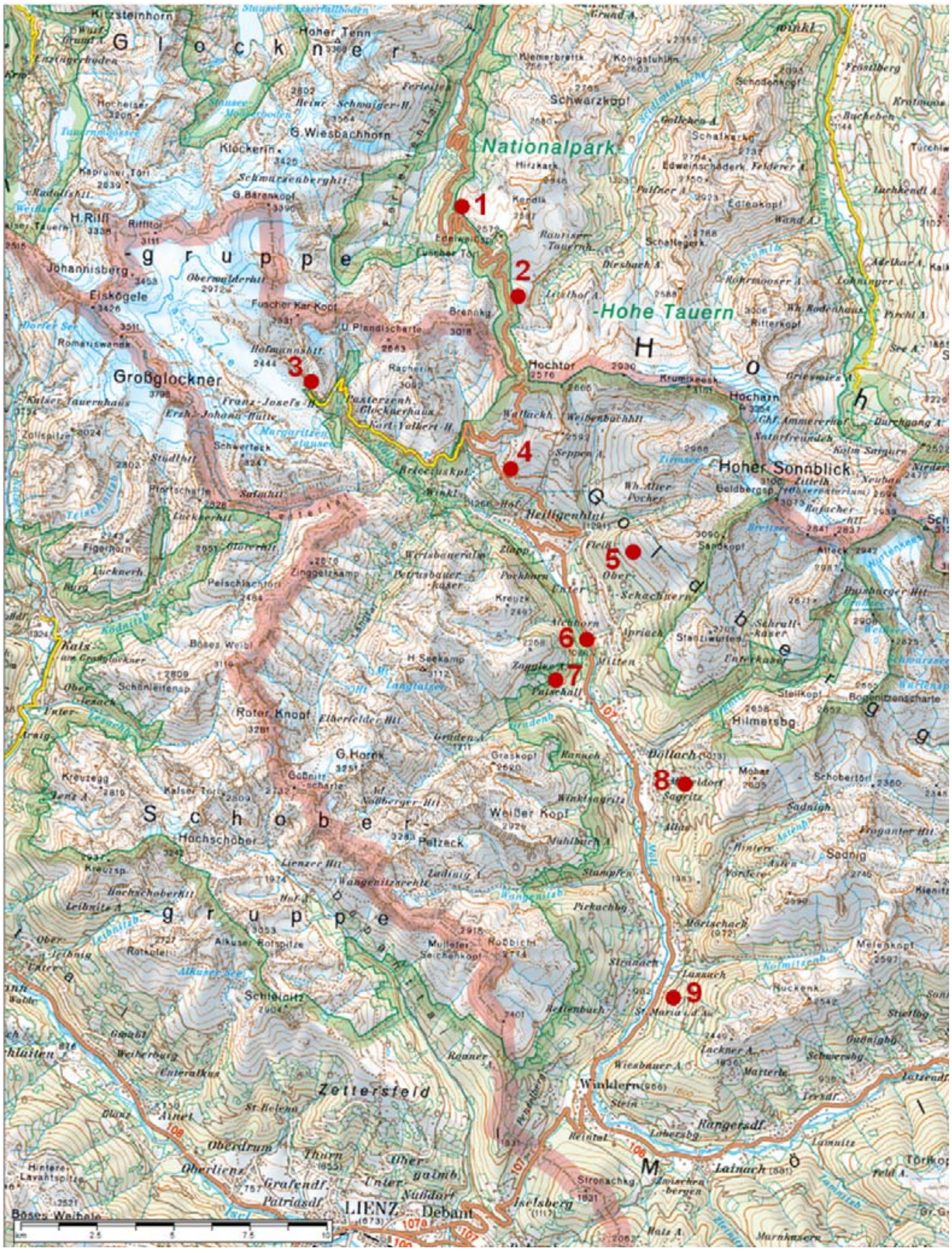

Figure 1a. Map with major locations along the excursion route.

The famous "Großglockner-Hochalpenstraße" is a pioneering work in high alpine road construction carried out 75 years ago which crosses the Alpine main chain at an elevation of around 2500 m a.s.l. Along the roadside various types of deep-seated mass movements are evident. Their occurrence is documented in one of the most detailed published geological maps of the Eastern Alps (CORNELIUS & CLAR, 1939). However, most of them have not been studied in detail from an engineering geological point of view.

SITE 1

The first evidence of gravitational mass movement along the road can be seen at the location "Hexenküche" (meaning "kitchen of the witches"; location 1 in Fig. 1a). The whole valley flank shows signs of rock mass creep, whereas parts of the flank are characterized by rock slide and rock spread phenomena within quartzite and quartzite schist overlying phyllite and calc-mica schist (Figs. 1b, 2).

SITE 2

An overview of the lithology of the Tauern Window will be presented at location 2 (Fig. 1a), where a geological study trail has been established by the Großglockner Hochalpenstraßen Company.

Figure 1b. Complex mass movement (rock slide, rock spread, rock mass creep) of "Hexenküche" as seen in Google Earth.

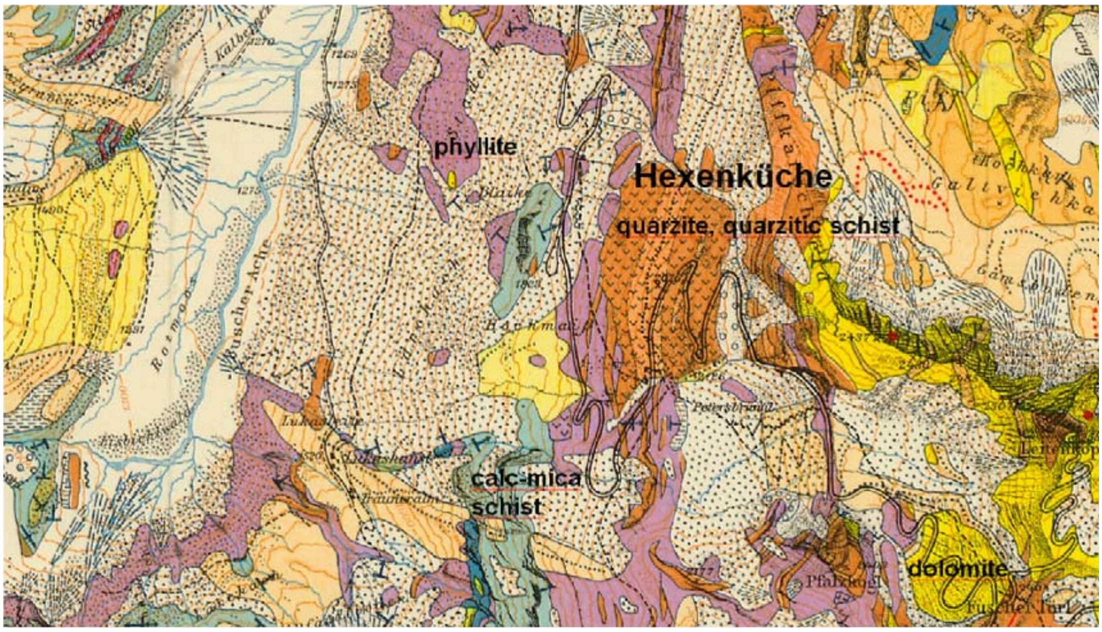

Figure 2. Detail of the geological map (CORNELIUS & CLAR, 1939) with the main lithological units indicated at the location "Hexenküche".

SITE 3

The Pasterze glacier (location 3 in Fig. 1a) is one of the biggest glacier tongues of the Eastern Alps located at the toe of the highest peak of Austria, the Großglockner (3798 m asl., Fig. 3). Its evolution, in the sense of massive down-wasting with a loss of appr. 50 % of the previous volume (WAKONIGG & LIEB, 1996) since the last glacial high-stand around 1850 and related processes of mass wasting, can be observed at the viewpoint Franz-Josefs-Höhe (2370 m asl.).

Figure 3. Tongue of Pasterze glacier (situation June 2007) and adjoining valley slope with indication of the extent of the 1850-high stand (not covered by vegetation). The down-wasting of the glacier surface (loss of thickness around 200 m) in the last 150 years resulted in stress release followed by rock fall (see also KELLERER-PIRKLBAUER et al., in press).

SITE 4

At the viewpoint Kasereck (1910 m asl.; location 4 in Fig. 1a) the south-eastern slope of the Wasserradkopf (3032 m asl.) can be seen, where a system of scarps and cracks indicates an increasing fracturing and disintegration of rock down the slope within a sequence of weak and brittle rock (calc-mica schist, serpentinite, phyllite, Figs. 4, 5, 6). This complex mass movement has not been studied in detail, but some geotechnical characteristics are known because the Großglockner high alpine road and some transverse structures of the Guttal creek have been affected by displacements. Thus, displacement velocities of a maximum of 1 to 3 cm/a have been detected by tape extensometer measurements between 1991 and 2003 (MOSER, unpublished data).

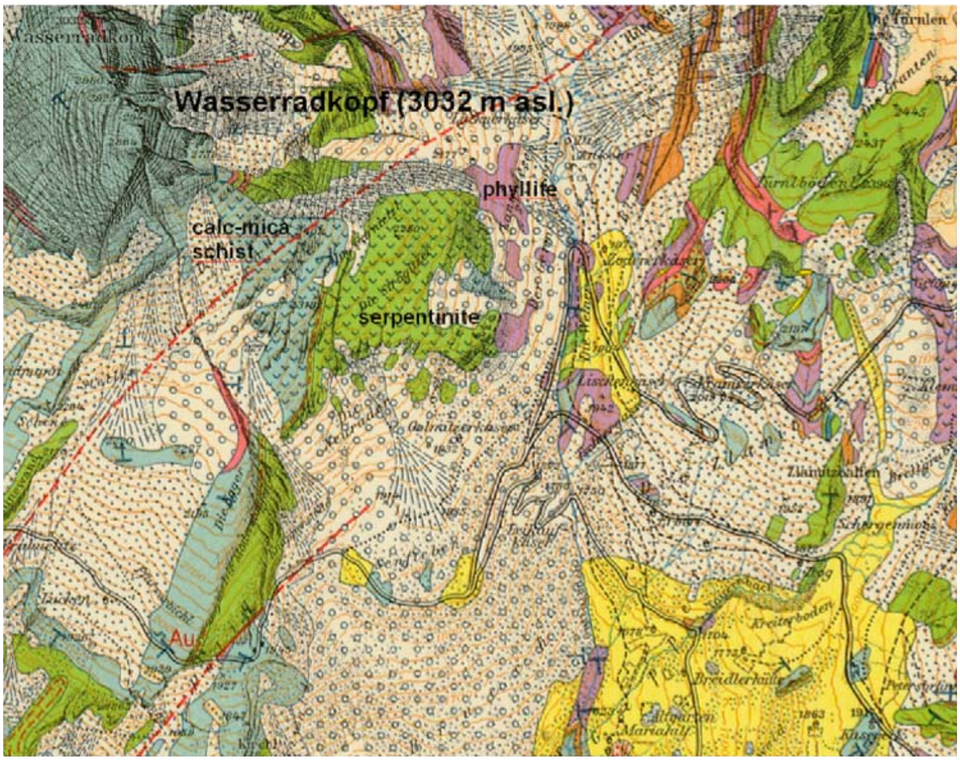

Figure 4. Detail of the geological map (CORNELIUS & CLAR, 1939) with the main lithological units indicated at the location "Wasserradkopf".

Figure 5. The south-eastern slope of the Wasserradkopf indicates intense fracturing and disintegration of rock due to a complex mass movement (rock spread, rock fall, rock mass creep, "Talzuschub" / "valley closure").

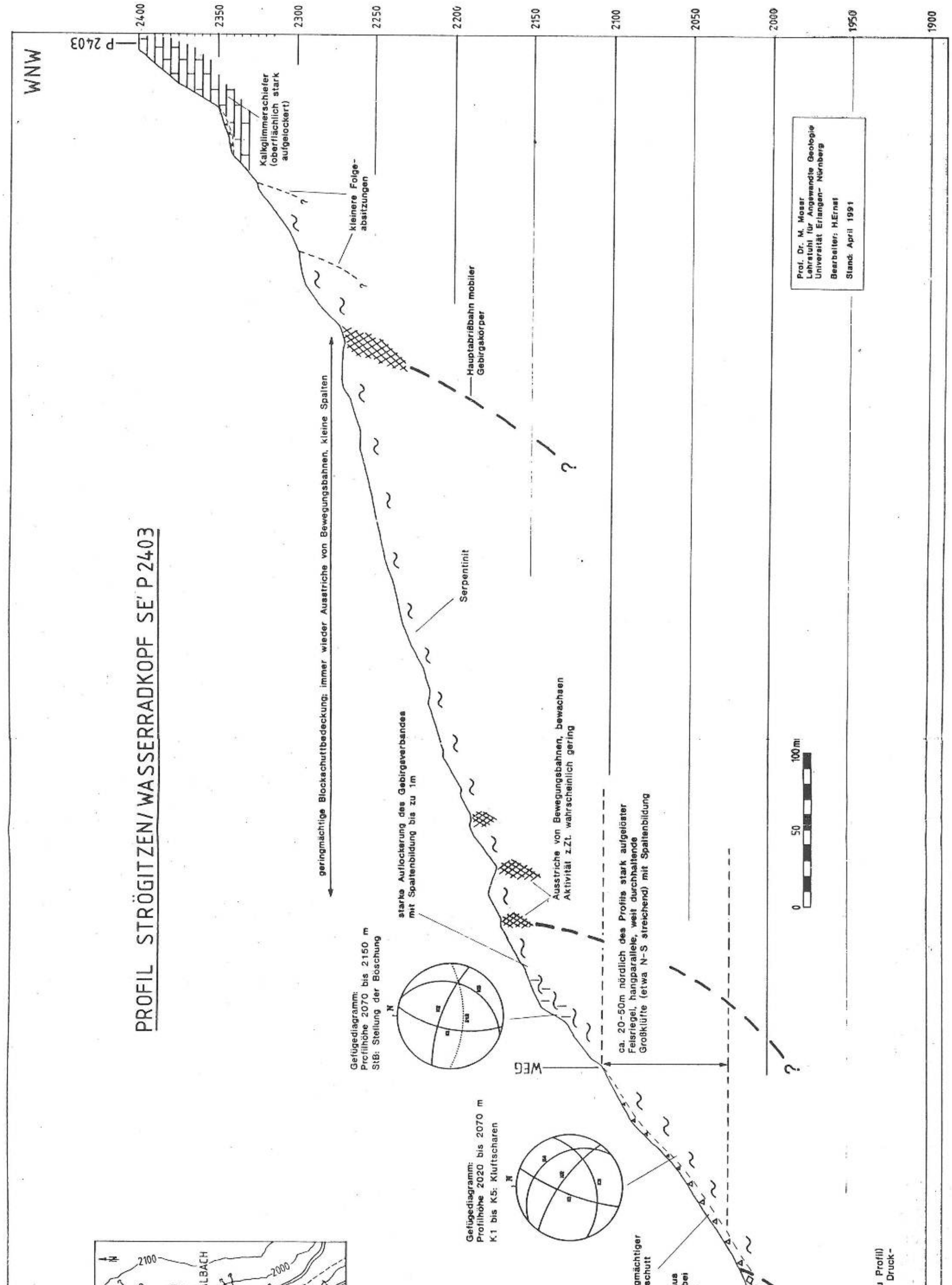

Figure 6. Geotechnical cross section within the south-eastern slope of the Wasserradkopf (MOSER, 1991, unpublished).

Further south we enter the Möll valley passing the picturesque village of Heiligenblut. Both flanks of the Upper Möll valley are characterized by several cases of deep-seated gravitational slope deformation:

SITES 5 and 6

On the left flank the complex mass movement of Mönchsberg - Apriach (location 5 in Fig. 1a) affected an area of around 10 km^2 (Fig. 7). Its northern part is characterized by a dip-slope situation within calc-mica schist. Here small scarps in the upper zone indicate mass wasting whereas the middle to lower slope shows signs of compressional structures (REITNER, work in progress).

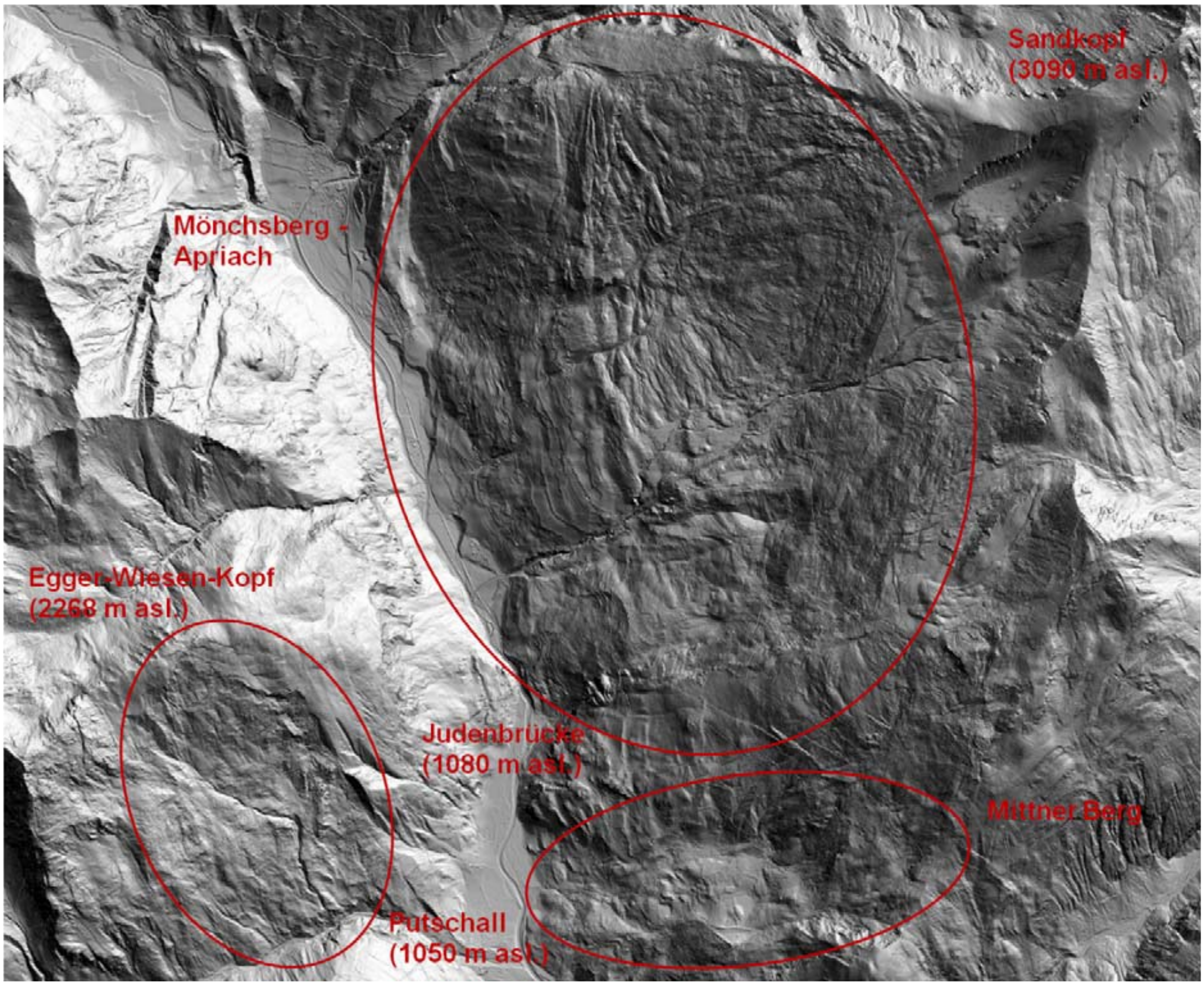

Figure 7. DEM with the main mass movement features between the villages of Heiligenblut and Döllach (DEM courtesy of provincial government of Carinthia - INTERREG IV A proj. MassMove).

In the southern part of this mass movement the slope deformation with scarps in the upper part and a convex toe occurred mostly in quartzite. The activity of some parts of this creeping mass movement is evident at the bridge Judenbrücke (location 6 in Fig. 1a) where the pressure from this valley flank causes damage to the road and forces the river Möll to undercut the opposite valley flank, generating tension gaps there as well. The unbalanced valley river long profile with a low gradient upstream of the “valley closure” (“Talzuschub”) and a quite steep one downstream reflects the impact of the gravitational processes on the valley floor development.

The slope failure of Mittner Berg (Fig. 7) within serpentinite with a zone of mass depletion / scarp area which is covered by basal till and a comparable convex lower slope indicates at least an initial formation before a major phase of glaciation (maybe before the last glacial maximum; EXNER 1962 & 1964; REITNER, work in Progress).

The intersection of the strongly tectonized Penninic Matreier Zone at the southern margin of the Tauern Window in contact to the Austroalpine units with the valley flanks results in the development of spectacular large scale mass movements (Egger-Wiesen-Kopf and Mohar).

SITE 7

The sagging slope ("Talzuschub") of the Egger-Wiesen-Kopf (location 7 in Fig. 1a, Figs. 7 and 8) within phyllite, calc-mica schist and prasinite on the left flank of the tributary Gradenbach valley is one of the best investigated mass movements with geotechnical and geophysical methods (WEIDNER, 2000, with references; BRÜCKL et al., 2006). This is due to the catastrophic events in 1965/1966, when extraordinary precipitation triggered dramatic accelerations of the slope movement with displacements in the range of meters to tens of meters. This caused blocking of the torrent at the toe which generated huge debris flows with a total volume of 1 mio m^3 destroying big parts of the village of Putschall (on the right Möll valley flank) and cutting the federal road in the Möll valley. Similar events with quite less damage were reported from the years 1882, 1903, 1935, 1942, 1957 and 1975. Current displacement velocities vary with locations and are in the range of a few cm to some 10 cm per year.

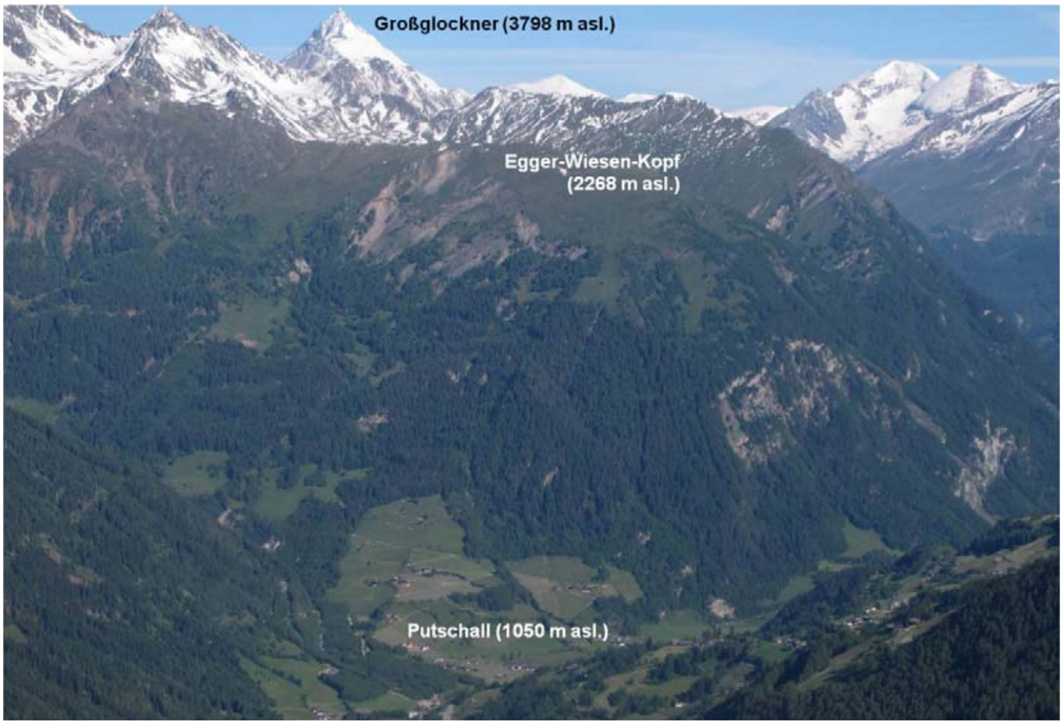

Figure 8. The Egger-Wiesen-Kopf sagging slope above the village of Putschall.

SITE 8

On the left flank of the Möll valley the Mohar landslide (location 8 in Fig. 1a) dissected a glacially shaped cirque in the upper part (Fig. 9). The process of slope failure is not completely deciphered yet. However, the material properties (matrix supported diamicton made of prasinite) of the lower slope indicate dynamic fragmentation and thus must probably represent a sturzstrom deposit. Close to the valley floor a cover of basal till on top of this deposit and the absence of big boulders point to a glacial shaping in the course of late glacial oscillations after the main event occurred (REITNER, work in Progress).

Figure 9. DEM with the Mohar mass movement which dissected a former cirque floor (DEM courtesy of provincial government of Carinthia - INTERREG IV A proj. MassMove).

SITE 9

Further down valley the valley flanks within the Austroalpine basement (gneiss, mica schist, amphibolite; FUCHS & LINNER, 2005) are characterized by slope failures in different stages of evolution, ranging from initial rock spread to fully developed sagging in a final stage (e.g. the Kräuterwiesen sagging slope - location 9 in Fig. 1a, "Talzuschub"; LOTTER, work in progress) with a classical concave-convex slope profile and strong rock disintegration in the toe zone (Fig. 10).

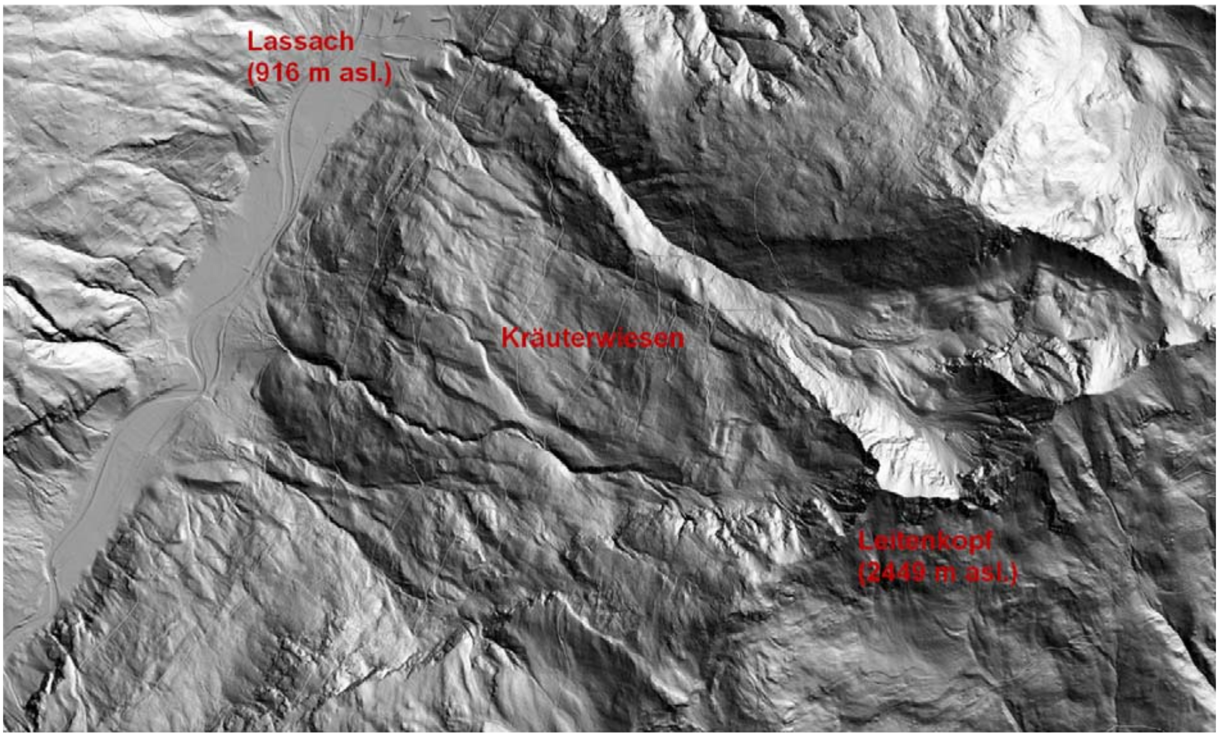

Figure 10. DEM with the Kräuterwiesen sagging slope (DEM courtesy of provincial government of Carinthia - INTERREG IV A proj. MassMove).

In general the geomorphological conditions of the mass movements in the Upper Möll valley are given by glacial erosion, i.e. glacial oversteepening of valley flanks and overdeepening of the valley floor during the last glacial maximum (Würm Pleniglacial) and partial re-shaping during the Lateglacial oscillations (Gschnitz stadial). Fluvial incision in the valley floors of tributary hanging valleys led to undercutting at the slope toe, and thus to an additional morphological setting for slope failure (e.g. Egger-Wiesen-Kopf).

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