Permafrost Excursion to Doesen Rock Glacier/Hohe Tauern

1. Basic information

The excursion goes to the Doesen Valley which is situated in the Ankogel group which is part of the Hohe Tauern Range (Central Eastern Alps, Carinthia/Austria).

Starting point: Mallnitz (1181 m a.s.l.), easily accessible by car or bus via the Moell Valley. Mallnitz-Obervellach is a station on the Tauern Railway which connects the Austrian federal countries Salzburg and Carinthia – thus enabling to easily reach Mallnitz by train from the South as well as from the North.

Duration: The excursion at least lasts a whole day because of the long ascent through the Doesen Valley to the rock glacier . An overnight stay at the refuge Arthur-von-Schmidhaus (2272 m a.s.l.) is recommended which offers the possibility also to climb the summit of Saeuleck (3086 m a.s.l.) with its splendid panoramic view.

Requirements: High alpine hiking tour with demand of good alpine equipment (solid boots, warm and water-proof clothes, shelter against sunburn). Yet the tour entirely runs on marked mountain paths so that there are no specific dangers for visitors except of situations with snowcover or bad weather conditions. For climbing Saeuleck good alpine experience is necessary.

Recommended time: End of June to end of September.

Maps: Oesterreichische Karte 1:50.000, sheet 3228 Bad Hofgastein and 3104 Obervellach; Alpenvereinskarte 1:25.000, sheet 44 Hochalmspitze Ankogel (the latter is the best available topographical map)

Further information: Besides the specific papers on Doesen rock glacier there is a compact guide-book for this excursion which runs along the so called “Blockgletscherweg Dösental” (i.e. rocj glacier trail Doesen Valley) which unfortunately is available in German only: Lieb G. K., Nutz M. (2009): Blockgletscherweg Dösental. – Naturkundlicher Führer zum Nationalpark Hohe Tauern, vol. 21, Innsbruck, 117 pp.

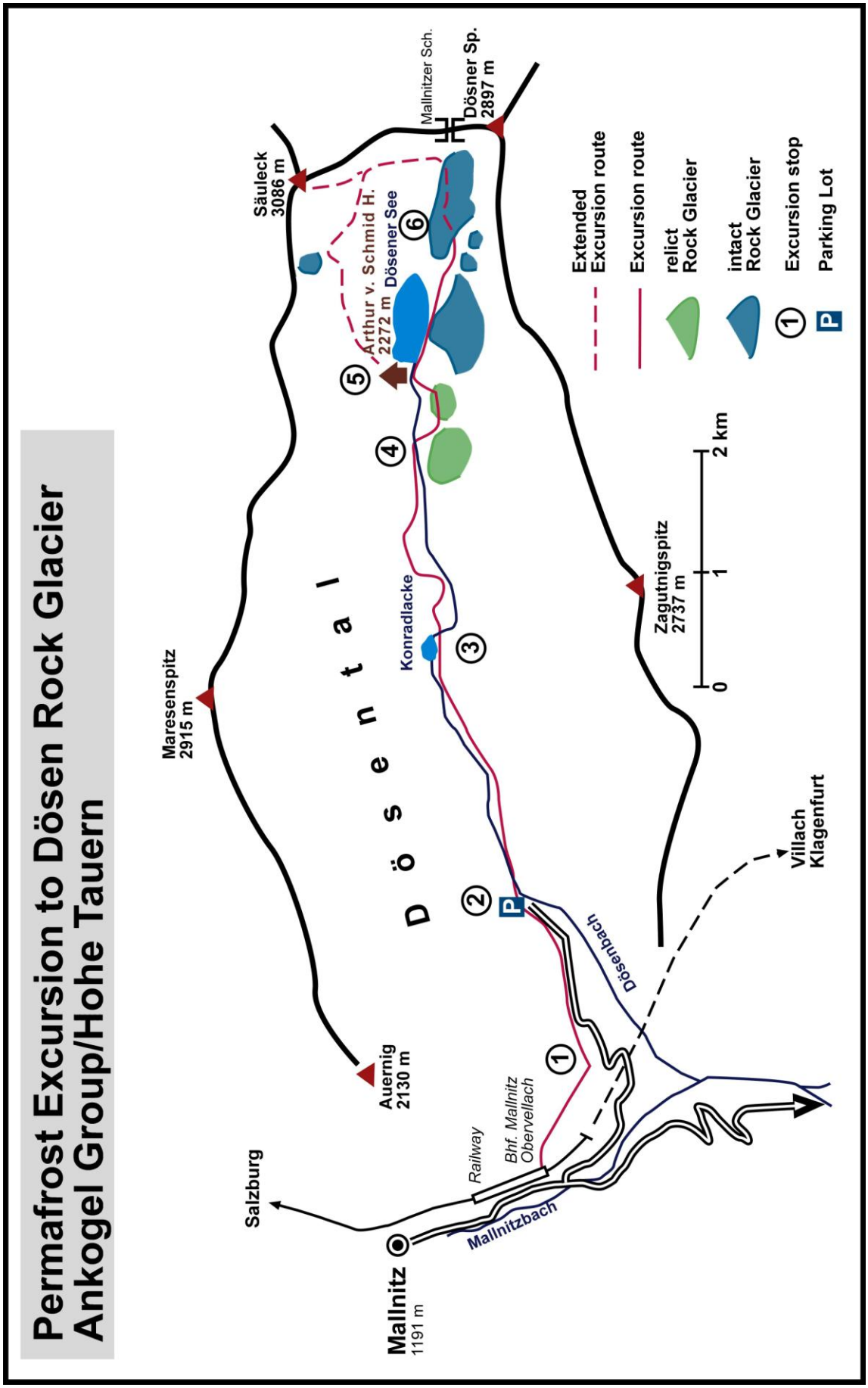
2. Permafrost and other high mountain features

The main topic of the excursion is the observation of the big rock glacier in the inner Doesen Valley which in terms of its dynamic behaviour ranks among the best known active rock glaciers of the Austrian Alps. There is a tradition of research since the 1990ies when Kaufmann et al. started annual geodetic measurements and photogrammetrical investigations which allowed reconstructing the rock glacier's movement and mass balance since 1954. Within the framework of several research programmes – in recent years ALPCHANGE and PermaNET – the behaviour of the permafrost system and its response to climatic conditions has been investigated in detail. E.g. besides a large number of ground temperature measurement sites a meteorological station and a remote digital camera have been installed in order to monitor the reaction of permafrost to changing environmental conditions.

Picture 1: Aerial view of the inner Doesen Valley from the West with Arthur von Schmid-Haus in the foreground, Doesen lake in the centre and Doesen rock glacier right above it (Photograph: Archive Lieb)

Furthermore the excursion offers the opportunity to study a great variety of elements of the high mountain environment and to have a closer look to the rock glacier's position within this system. Among these features are:

- Relict rock glaciers of Late Glacial age
- Moraines giving information on Late Glacial climatic history
- Altitudinal limits of vegetation, especially the timberline ecotone
- Erosional and gravitational processes on steep slopes, especially debris flows
- Traditional landuse systems and their altitudinal differentiation
- Environmental protection within Hohe Tauern National Park
- High alpine lakes and lacustrine ecosystems
- Natural hazards and hazard protection



Picture 2: Overview map (with excursion route and stops)

3. Itinerary

The excursion starts in Mallnitz (1181 m a.s.l.) at the railway station Mallnitz-Obervellach. From here a marked path (sign 510) leads through the interesting cultural landscape of the loosely inhabited settlement Doesen where traditional high-mountain farming has well been preserved. After a steep ascent to the restaurant "Zur schönen Aussicht" (1372 m a.s.l., stop 1) the trail reaches the road to the parking lot near the first bridge over the Doesen creek (1447 m a.s.l., stop 2) where the educational "rock glacier trail" begins. The walking time of 70-90 minutes can be avoided when a car or a small bus is available or a taxi van (Nationalpark Taxi) has been booked. Yet going up here by a motor vehicle deteriorates the possibilities to observe the landscape and the morphological situation described in stop 1.

The rock glacier trail (continuously well marked with sign 510) follows the valley bottom near the creek passing the subalpine pastures of Eggeralm and the spring Kritzbrunn (with a good impression of the glacially derived shape of the valley) before it becomes steeper climbing a debris cone which dams a little lake (Konradlacke, 1618 m a.s.l., stop 3). Here the trails narrows considerably and subsequently ascents a steep slope at the end of which there are some huts which serve as shelters for hunters and shepherds (Doesener Huette, 1974 m a.s.l.). From here it is only a quite small distance to Lackenboden (2076 m a.s.l., stop 4) on which Doesen creek forms a picturesque braided river system surrounded by larches forming the upper margin of the timberline ecotone. A final steep ascent leads to Arthur-von-Schmid-Haus (2272 m a.s.l., stop 5) which is situated at the lakeside of Doesen Lake amidst a spectacular high mountain scenery. The walking time is some 2 ½ hours.

From the refuge run by the Austrian Alpine Association and offering a restaurant as well as good accommodation you continue along the southern lakeside towards the head of the valley where you can already see the impressive tongue of the Doesen rock glacier (which however is not the only intact rock glacier in the surroundings of the lake). The track becomes steeper again approaching the rock glacier and finally reaches its surfaces via a slope of loose talus which requires specific attention (approx. 2430 m a.s.l., stop 6). Walking time from Schmidhaus 40-50 minutes.

The way back to Schmidhaus is the same (30-40 minutes), from here to the parking lot it will take you 90-120 minutes and to Mallnitz another 50-60 minutes.

An alternative offering a better overview of the entire Doesen rock glacier system is the mountain path 534 which leads from Schmidhaus in some 2 ½ hours to the summit of Saeuleck (3086 m a.s.l.). This summit can also be reached when you continue from stop 6 across the entire rock glacier to the depression at its upper margin and then turn to the left to Saeuleck which yet is a quite difficult alternative with a duration of some 2 hours. For the descent from Saeuleck to Schmidhaus you calculate some 2 hours.

4. Suggested excursion stops

Stop 1: *Doesen, "Zur schönen Aussicht" (1372 m a.s.l.)*
The former restaurant whose name means beautiful viewpoint is situated on a ridge high above the Mallnitz Valley. To the South one can see Polinik (2785 m a.s.l.) the highest summit of the Kreuzeck Mountains which towers 2100 m above the bottom of the Moell Valley. To West there is an instructive view of the Goldberg mountains (Vorderer Gesselkopf, 2974 m a.s.l.) whose name remains the visitor of the medieval mining of gold. In Eastern direction there is the first view into Doesen Valley which is dominated by the elegant rock pyramid of Saeuleck (3086 m a.s.l.). In the meadows and pastures which are the predominant land use type in the closer vicinity coarse boulders of prasinite (metamorphic vulcanite) attract attention. These boulders have been accumulated by a huge rockslide which probably tool place in the younger Holocene. The material came down from the slopes in the North of the stop where the starting zone of the rockslide is still visible by the semicircular depression between Auernig (2161 m a.s.l.) and Torlkoepfe (2442 m a.s.l.). The slide dammed the Mallnitz Valley forcing the Mallnitz River to form a lake whose remnants are still visible in lacustrine terraces. Afterwards the river cut through the rockslide dam forming a narrow canyon named Rabischschlucht (which can be visited via a spectacular trail). The exact age of the rock slide is not known, its reason was probably slope failure because the oversteepening action of the glaciers which had covered the area up to at least 2300-2400 m during the last glacial maximum.
The mountains to the West, North and East of the stop are composed of a variety of rocks belonging to the penninic Tauern Window. Its base is formed by a core of metamorphic granitic rocks and amphibolites which occur in the inner Doesen Valley. These are covered by schists and a series of rocks which originate from a deep-sea environment of the penninic ocean (among them the above mentioned prasinite) building the outer part of Doesen Valley an the Goldberg mountains in the West. All strata dip towards the West being the reason for asymmetric landforms which can also be seen when walking through the Doesen Valley. Mount Polinik to the South belongs to the crystalline basement of the Central Eastern Alps which has a tectonically higher position (Austroalpine unit) than the Tauern Window (Penninic unit).

Stop 2: *Parking lot at the beginning of the "rock glacier trail" (1447 m a.s.l.)*
Here is the official starting point of the educational "rock glacier trail" which is introduced to the visitor by a big information board. This trail was the first one in Austria (and one of the first ones in the entire Alps) which concentrated on the topic of permafrost and climate change. It has been established in 2002 by Hohe Tauern National Park following a concept which was developed at the Institute of Geography and Regional Science of the University of Graz by M. Nutz. Except of two information boards (one here and one at Schmidhaus) there are only post with numbers on the trail itself thus protecting the landscape from additional installations. The posts refer to information which has at first been given in a folder and since 2009 in the above mentioned guidebook which was published by the Austrian Alpine Association. There are two types of recommended stops, points of experience and points of experience. The stops described here only partly correlate with those in the guide-book.

Picture 3: View in Western direction to Konradlacke which is dammed by large debris cones; the debris flows to the left have their source area in permafrost which is probably degrading. Note the transversal profile of the glacially shaped valley.

Stop 3: *Konradlacke (1618 m a.s.l.)*

As already mentioned Konradlacke is a small lake dammed by a huge debris cone whose catchment area is the Mitterkeiltal to the South. This gorge which follows a tectonic fault has a vertical distance of almost 1000 m with the uppermost part being situated within an area of probable permafrost occurrence. This is proved by modelling of permafrost distribution using different approaches and by perennial snow patches existing at least in some years. The cone itself obviously has been accumulated during most of the Holocene. Its western part is not active any more (but could be reactivated any time) but on the eastern part some larger debris flows occurred in recent years also damaging the rock glacier trail. The only hazard protection measure was the partial removal of the sediments by bulldozing thus creating a flow channel enabling future debris flows to reach the natural storage basin of the lake. It is quite probable that the recent events have partly been triggered by degrading permafrost in the rock faces at both sides of the Mitterkeiltal.

There is another debris cone on the opposite side of the valley which has been very active in recent years, too. Both debris cones form a threshold with a height of some 100 m contributing to the staircase-like longitudinal profile of Doesen Valley. In this sediment barrier Doesen creek sinks and springs again from its lower margin (Kritzbrunn spring). Due to the permeable sediments the level of the water surface of Konradlacke is highly variable and after long periods without precipitation it even is likely to disappear.

Stop 4: *Lackenboden (2076 m a.s.l.)*

After crossing Doesen creek the path climbs a steep slope and reaches a small plateau like landforms built of sediments with predominance of coarse blocks on the surface. It is a relict rock glacier which developed in a foot slope position during Late Glacial times. While in the Younger Dryas period (11.500-10.500 years before present) a glacier still covered the innermost part of the valley (see stop 5) the area here was already ice-free and prone to periglacial processes. A higher age is improbable because during the older stages of the Late

Glacial period this location should still have been covered by the Doesen Valley glacier. When looking down valley you see another relict rock glacier at the foot of the same slope and in the same exposure (North). Its lower limit is situated at about 2020 m which is 320 m lower than the current snout of Doesen rock glacier. This figure indicates – together with the observation of dwarf pine (Pinus mugo) and larches (Larix decidua) growing on the surface – that this relict rock glacier is obviously older than the Holocene.

Picture 4: View in western direction onto the relict rock glacier near Lackenboden. The frontal slope has been smoothed due to the complete melting out of the ice and the surface is partly covered with vegetation.

Stop 5: *Arthur-von-Schmid-Haus (2272 m a.s.l.)*

In the vicinity of this mountain remnants of former glaciations attract attention, especially a moraine ridge which is situated right upon the threshold of the cirque. This moraine is assumed to be of Younger Dryas age thus belonging to the Egesen Advance which had its maximum extent around 11.000 years ago. Unfortunately an absolute dating of the moraine has not yet been possible. Nevertheless it can be assumed that the temperature increase after that advance made glaciers disappear in the Doesen Valley – even during the Little Ice Age (17th -19th century) only perennial snowfields, but no glacier existed which fact is proved by the absence of moraines. Thus space became available for the development of rock glaciers whose sediments cover the North facing slopes of the valley head nearly entirely. Besides some protalus ramparts on the talus cones two big rock glacier systems can be distinguished: (1) an inactive lobate-shaped rock glacier (length 400 m, maximum width 800 m) beneath Seeschartl und Dullater Nock (2656 m a.s.l.) and (2) the active Doesen rock glacier (length 1000 m, maximum width 300 m) creeping down from Mallnitzer Scharte (2672 m a.s.l.) towards the observer. An information board (Schautafel) gives explanatory notes on the rock glacier and some aspects of research carried out on it.

When looking to the Southeast you see the rocky but relatively low peak of Dullater Nock (2656 m a.s.l.) and the narrow pass of Seeschartl (2638 m a.s.l.) to right of it. The continuation of route 510 leads up there connecting Schmidhaus with the central Reisseck Mountains via the so called “Reisseck Hoehenweg”. Because rock fall events from the summit face of Dullater Nock had become more frequent since the 1990ies again and again blocking the trail. Although fortunately no accidents happened the route of the trail had to be changed in 2007. Since then it runs across the central part of the talus cone avoiding the area

affected by rock fall. Also in this case the reason for the increase in rock fall activity was degrading permafrost the existence of which has been proved by ground temperature measurements. In recent years the reconstruction of many a high alpine path has become necessary.

Picture 5: Lateral view from the South to the snout of Doesen rock glacier. The picture clearly shows all typical features of an active rock glacier with the steep and instable frontal slope and the blocky surface which roughly represents the active layer.

Stop 6: *Rock glacier surface (approx. 2430 m a.s.l.)*

Doesen rock glacier ranges from 2897 to 2339 m a.s.l. The first value represents the summit of Doesener Spitz being the highest point of the surroundings of the rock glacier from where it is nourished by heavily weathered granitic gneiss. Its frontal slope is 35-40° steep at the foot of which there is a big spring which is the most important water supply for Doesen Lake. The mean thickness of the rock glacier is estimated at 30-40 m according to the results of geophysical soundings, the total volume is approx. 15 million m^3. In 1995 a long-term geomorphometric monitoring programme has been started by Graz University of Technology under the leadership of V. Kaufmann. In addition photogrammetric, cartographic and differential SAR interferometric work has been carried out resulting in an accurate knowledge of the surface kinematics of the rock glacier. The mean surface velocity over the last half century amounted to 26 cm per year which value corresponds well to the results from other Alpine rock glaciers of comparable size. Yet the speed changed considerably during that time, e.g. after a period of reduced activitiy in the 1980ies higher velocities are measured since 2000. This is probably due to the temperature evolution which causes higher deformation rates in warmer periods.

All characteristic features of an active rock glacier are well visible from here or from the course of the rock glacier trail which ends here. The rock glacier surface is covered by coarse blocks which make walking on it dangerous and difficult. This is why only well experienced hikers – i.e. only selected student groups – should continue the way further up though it is very impressive to walk along the rock glacier in its total length.