

Fründenhütte refuge, Kandersteg (BE), June 6 2010 - Avalanche triggered by third party.¹

Around midday, nine young people became victims of an accident as they were descending from the Fründenhütte refuge. A downhill skier higher up the mountain released a loose snow avalanche. Both the skier and two of the nine persons descending from the refuge were overwhelmed by the sliding snow masses. The avalanche snow swept one man in the group over steep precipices about 200 metres down the mountainside. He died before being reached by rescuers.

Sequence of events and rescue mission

On Sunday June 6, the traditional spring ski race was taking place for the 67th time on the Fründengletscher glacier. Around midday in the Fründenhütte refuge Participant A came across the group of nine English speakers who were to be involved later in the avalanche accident. He spoke with them and said goodbye as they departed from the refuge. About 10 to 15 minutes afterwards, he likewise set off for the valley. He intended to ski down the final snow-covered slope below the refuge as usual and then, just before the passage across the rock face, to continue his descent on foot. After putting on his skis, he looked around to make certain that nobody was below him on the mountain. He did not see anyone and assumed that the group was already further down and had reached the passage. He therefore began his downhill run (Fig. 1). After making a few turns he was caught from behind by a small, wet, loosely packed snow avalanche. He fell to the side and was carried by the snow masses over a ledge. He continued to slide down the mountain for a further 30 m or so before he was able to arrest his fall with his skis a few metres above a scarp. He did not suffer any injuries.

Just before bringing his slide to an end, he caught sight of the group again. Having removed his skis, he saw that a woman belonging to the group, who was making the descent in fourth place, had evidently been caught by the sliding snow masses. She was lying on the downslope path a little further down the mountain, which was made safe with rebars and steel cable fastened to the rock as a handrail. Her clothing and backpack had become entangled in the rebars and prevented her from falling further. Participant A was familiar with this place and quickly made his way to assist the motionless woman; he saw that she was seriously injured. He immediately administered first-aid. He

instructed one of the men in the group to hike back up to the refuge straight away and sound the alarm. Not until then was it noticed that the man who had been descending with the group in fifth place was missing. He must have been overwhelmed by the snow masses on the unsecured section of the refuge trail and swept over several high ledges.

The accident occurred between 11.50 am and noon. At 12.15 pm the first rescue helicopter sighted the missing person while approaching the accident site. He was lying motionless, but was not buried, around 200 m below the place where he was swept away on the edge of the Mittelschnyda lateral moraine. The doctor in the helicopter therefore decided to go immediately to the aid of the seriously injured woman first. Once first-aid had been administered, the patient was flown to the University Hospital of Berne accompanied by a doctor. The body of the young man belonging to the group, who sustained fatal injuries when falling to the Mittelschnyda moraine, was recovered by another helicopter crew and flown to Frutigen.

Weather and avalanche situation

Early June was cool and, at lower altitudes, rainy. Around 10 to 20 cm of snow is estimated to have fallen above approximately 2500 m. From June 4 the weather was dominated by a high-pressure system, and the zero-degree level climbed to approximately 4000 m as early as June 5. On the day of the accident it was sunny in the morning and the temperatures were mild. For this reason, the snow-pack is unlikely to have frozen significantly at this altitude during the night. During the day, cloud built up from the southwest. At the time of the accident, however, visibility was good and the terrain was accordingly discernible.

Avalanche bulletin

The most recent avalanche bulletin had been issued on May 31 (valid until June 4). In view of the snow that was falling at the end of May and beginning of June, it warned of heightened avalanche danger and indicated that moist avalanches and snowslides could be expected as a consequence of solar radiation and rising temperatures. The new fallen snow, it reported, could slide on the old snow-pack. This danger had to be expected on the first one or two sunny, warm days in particular.

An avalanche bulletin was not issued on the day of the accident. On this day, already the third day

1. Extract from: Etter, H., Stucki, T., Techel, F., Zweifel, B. 2012: *Schnee und Lawinen in den Schweizer Alpen. Hydrologisches Jahr 2009/10. Davos, WSL-Intitut für Schnee- und Lawinenforschung SLF, 81 S., Seiten 77 – 79, Translation: TTN Translation Network*

with mostly warm and sunny weather, the heightened danger of dry avalanches, wet loose snow avalanches and wet snow slides was estimated to have passed.

Additional notes

On June 7 the competent examining magistrate ins-

trusted the SLF to inspect the accident site with a view to gathering evidence for a possible expert opinion. The inspection took place on June 8 and formed the basis of an expert opinion produced thereafter by an SLF employee. Among other things, the report pointed out that heightened avalanche danger did not prevail on the day of the accident.



FIGURE 1 – The area in which the accident occurred to the southeast of Oeschinensee with the Fründengletscher at the top of the picture, showing the Fründenhütte refuge (F) and the accident site. The red broken line traces the skier's downhill route and the blue broken line the approximate fracture of the avalanche that preceded the accident; the blue arrow indicates the direction of the plummeting snow masses. The red circle marks the place where the two victims belonging to the group were situated when they were swept along by the loose snow avalanche. The place where the body of the fatally injured man was found is well below the picture frame (photo: SLF/J. Schweizer).

Remarks

- There is no doubt that the skier waited until there were no longer any persons situated in the fall line of his downhill run. He was thus taking a customary precaution. The time he allowed to elapse, however, was evidently insufficient. The group of nine hikers must have been making ge-

nerally slower progress than anticipated by the skier. There is an essential lesson to be learned here, especially by inexperienced hikers.

- At the time the present report was issued, it is not known whether the examination was to be suspended or a legal action brought.

Avalanche data

Avalanche			
Map No.	1248	Min. fracture depth [cm]	–
Length [m]	300	Mean fracture depth [cm]	–
Width [m]	10	Min. fracture depth [cm]	10
Terrain			
Aspect	N	Slope angle on map [°]	35
Altitude	2520	Type of terrain	Bowl
Release information			
Release type	person	Safety distances	–
No. of triggering persons	1	Activity	Skiing/hiking/walking
No. of involved persons	3	Tracks	Untracked slope
Involved person		Type of burial	Duration of burial
1 st person	fatal	not buried	–
2 nd person	injured	not buried	–
3 rd person	uninjured	not buried	–

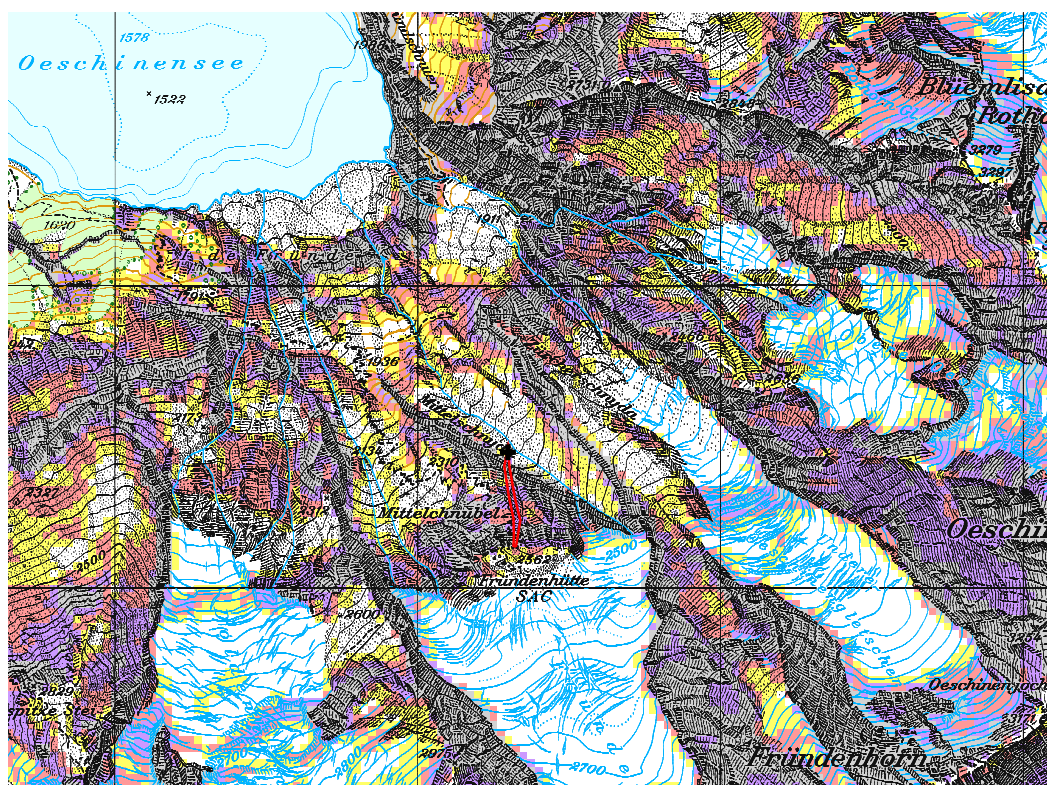


FIGURE 2 – Map section of accident site (1:25,000, national map sheet 1248) showing the outline of the avalanche (red) and the place where the victim was found. Map reproduced with permission from swisstopo (JA100118/JD100040).

Monte Rosa refuge, Zermatt (VS), March 20 2011 - Avalanche after dark.¹

Having missed the customary route for the final ascent to the Monte Rosa refuge, a backcountry touring group were seeking to cross a steep moraine slope in the dark. The two members leading the group triggered a wide avalanche and were overwhelmed by it. One of them was buried deep and died before being reached by rescuers.

Sequence of events and rescue mission

Six backcountry skiers from Germany were taking part in a week's tour without a guide. On the day of their arrival, March 19, they decided not to climb the Allalinhorn because of critical avalanche conditions (avalanche danger considerable, level 3). They instead ascended to the Britanniahütte refuge (3030 m).

At 8 am on the day of the accident, the group left the refuge for the long trek via the Strahlhorn (4190 m), Adler Pass and Stockhorn Pass to the Monte Rosa refuge. Shortly before 6 pm, they notified the warden of the Monte Rosa refuge that they expected to arrive in about an hour's time. They had assessed their position inaccurately, however, and were actually 100 m further down the mountain than they had thought.

After failing to find the normal ascent to the refuge, they selected a different route. Around an hour after darkness fell, the two persons at the front of the group began to make a trail on a very steep slope descending to the west. Due to its steep gradient, the second of the two waited at the edge of the slope. Because the slope was in the shadow of the moon, they were moving in almost utter darkness except for their headlamps. While the first man was traversing the slope, an almost 200-metre wide slab was released about 10 to 15 m above him (Fig. 1). The avalanche swept him down to the glacier. He was buried to a depth of around 2 m. The second person was likewise overwhelmed by the slab. This victim was swept along and partially buried. He was able to free himself, however, and alert the mountain rescue service. The other members of group did not know that an avalanche had been released because they were following at a distance of around 200 metres. They did not become aware of the avalanche until noticing that the ascending trail came to an end in front of them. They immediately launched a search. By the time the mountain rescuers arrived, they had roughly located the person who was buried. He was buried so deep, however, that he was not freed from the snow masses until a period of 50 minutes had elapsed (Fig. 2). Unfortunately, the victim had already died.



FIGURE 1 – Avalanche fracture, showing the backcountry skiers' route across the slope. The around 200-m wide slab fractured on the very steep west facing slope containing large blocks of rock below the Monte Rosa refuge (photo: Valais cantonal police, 21.03.2011).



FIGURE 2 – Avalanche deposit showing the place where the body was found (circled). The victim was buried beneath 2 m of snow (photo: Valais cantonal police, 21.03.2011).

Weather and avalanche situation

Weather conditions had been variable on the days preceding the accident. Snow fell occasionally; the wind was generally light, intermittently at moderate velocity. In mid-March the bonding of the snowpack was unfavourable over a large area. On shady slopes in particular, the preceding weeks' freshly fallen snow and snow drift accumulations were deposited atop of faceted layers of snow. Other avalanches that released during this period were characterised in many cases by the snowpack fracturing at its centre; layers of fresh and drifted snow had slid over faceted layers. The avalanche that gave rise to this accident exhibited a similar sliding

1. Extract from: *Techel, F., Pielmeier, C. 2013: Schnee und Lawinen in den Schweizer Alpen. Hydrologisches Jahr 2010/11. Davos, WSL-Institut für Schnee- und Lawinenforschung SLF, 95 S., Seiten 72 – 75, Translation: TTN Translation Network*

surface (Fig. 3).

During the night before the accident, 10 to 20 cm of snow fell in the region where it occurred. On the day of the accident the weather was sunny and the wind was light.

Extract from the National Avalanche Bulletin for March 20 2011, valid for the region in which the accident occurred:

- *Avalanche danger forecast: Considerable avalanche danger (level 3)*

The avalanche prone locations are to be found primarily on steep slopes of southwestern to northern to southeastern exposition, and in areas adjacent to ridgelines and pass areas in all expositions, above approximately 2200 m. The major peril stems from the new fallen snow from the last few days, together with the freshly formed snowdrift accumulations. Avalanches which attain medium size are possible. Particularly on north facing slopes, it is possible to trigger avalanches in the old snowpack. In addition, freshly formed, usually small sized snowdrift accumulations should be avoided whenever possible. For backcountry skiing and freeriding tours in all regions of the Swiss Alps, experience in the evaluation of avalanche hazards is imperative. Due to the daytime warming cycle, the likelihood of dry avalanches being triggered will escalate somewhat over the course of the day.

Remarks

This accident was caused by a combination of several factors.

The snow conditions were difficult; it fell to the person leading the group to find and forge a viable trail for the others, even when skiing downhill. As a consequence, the group were still on the mountain at a relatively late hour. In addition, they did not find the normal route for the ascent to the Monte Rosa refuge and descended too far. After phoning the warden of the refuge, they discussed what action to take next, but estimated their position inaccurately. Believing the direct ascent from their current

position to the refuge to be too dangerous, they planned to take a detour and ascend from the west on a route that was not usually used. As they were ascending to the west of a small lake, night fell. For that reason, both orientation and the task of assessing the terrain became increasingly difficult.

The avalanche was released on a seldom-used moraine slope containing large blocks of rock. It is likely that the bonding of the snowpack was especially unfavourable there.

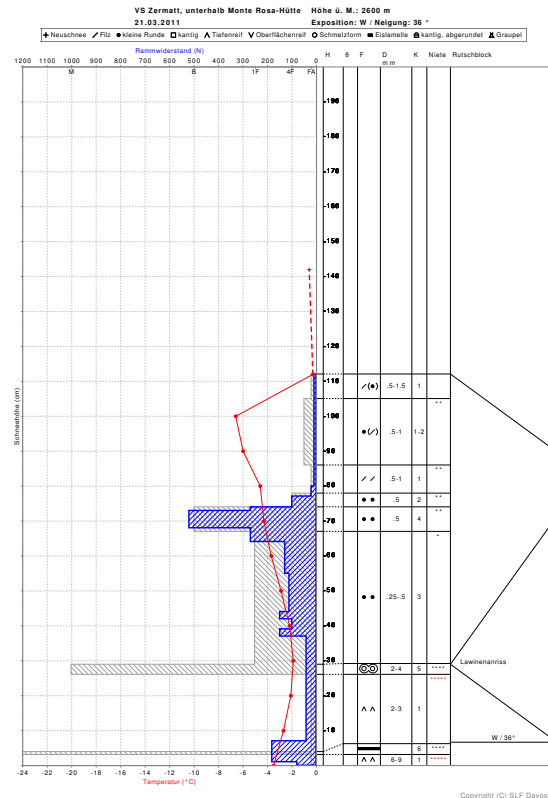


FIGURE 3 – Snow profile with rutschblock test, recorded where the avalanche fractured on the very steep west facing slope below the Monte Rosa refuge in Valais on March 21, one day after the avalanche occurred. The slope is a very rocky lateral moraine of the Grenzgletscher glacier. The avalanche slid on the crust lying at 29 cm. The hand-hardness profile is shaded pale grey, and the ram-resistance profile is shaded blue.

TABLE 1 – Weather conditions in the region where the accident occurred, as measured by manned and automatic stations. All the values were recorded at 8 am and reflect the conditions of the preceding 24-hour period (24-hour total or mean, as appropriate).

Date	Air temp. (°C) GOR1 ^a	mean wind strength (km/h)/direction GOR1 ^a	Fresh snow (cm) ZER4 ^b	Fresh snow (cm) 4ZO ^c
15.03.2011	-5	18 – SE	0	0
16.03.2011	-6	17 – NE	0	0
17.03.2011	-7	8 – SE	24	12
18.03.2011	-7	9 – S	0	0
19.03.2011	-9	7 – SE	0	6
20.03.2011	-9	8 – SE	10	4

^a GOR1: ENET station Gornergrat 3130 m; distance of 3.1 km.

^b ZER4: IMIS snow station Zermatt, Alp Hermetje 2380 m; distance of 8.5 km.

^c 4ZO: Observer station Zermatt Ost, Eisflue 2235 m; distance of 7.1 km.

Avalanche data

Avalanche			
Map No.	1348	Min. fracture depth [cm]	–
Length [m]	170	Mean fracture depth [cm]	60
Width [m]	180	Max. fracture depth [cm]	–
Terrain			
Aspect	WNW	Slope angle on map [°]	37
Altitude	2630	Type of terrain	Rocky, steep terrain
Release information			
Release type	person	Safety distances	yes
No. of triggering persons	1	Activity	Skiing, backcountry tour, ascent
No. of involved persons	2	Tracks	no
Involved person			
1 st person	Injury fatal	Type of burial fully buried	Duration of burial 50 min.
2 nd person	uninjured	partially buried	–

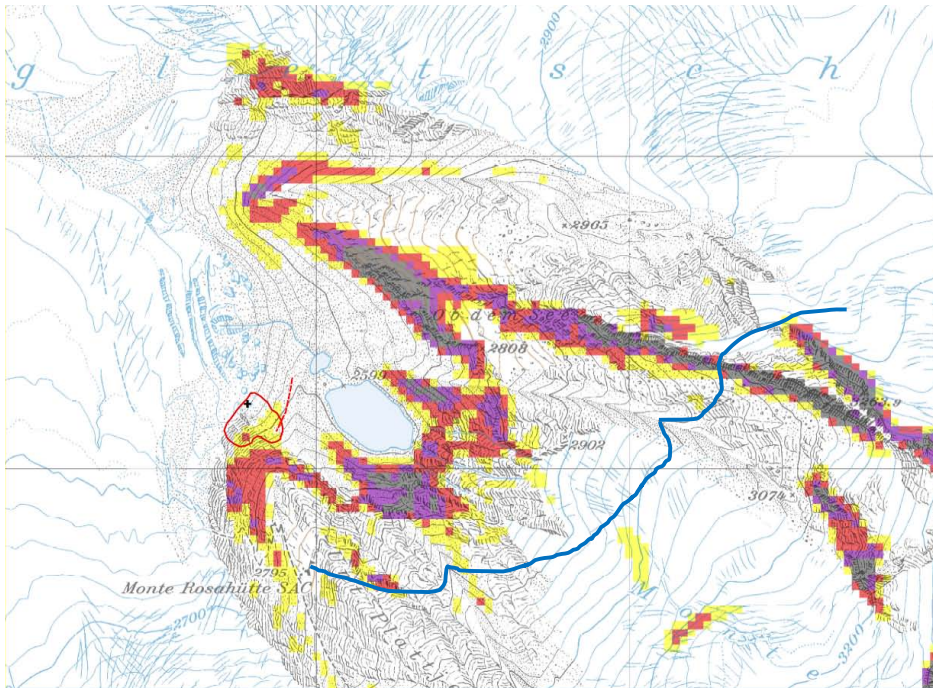


FIGURE 4 – Map section of accident site (1:25,000, national map sheet 1348) showing the outline of the avalanche (red line), the ascent trail (red broken line), and the place where the victim was found (black cross). The blue line depicts the normal route from the Gornergletscher to the Monte Rosa refuge. Map reproduced with permission from swisstopo (JA100118/JD100040).

January 3 2012, Juferhorn, Avers (GR) – Group of four engulfed by avalanche. Two killed.¹

An avalanche overwhelmed all four members of a ski touring group as they made the ascent to the Juferhorn. Rescuers were alerted by the only member of the group who was not completely buried. Help arrived too late for two of the completely buried victims.

Sequence of events and rescue mission

On the morning of January 3, a group of five back-country skiers were planning an ascent in the direction of the Juferhorn (2967 m). They had consulted the avalanche bulletin and were very well equipped. Before leaving, they performed a transceiver test. One of the group felt unwell and decided to remain in the valley. The other skiers began their ascent, without maintaining any spacing, to the south of the Mugmolbach stream. As the group were ascending the steepening summit slope, a slab avalanche was released about 80 m above their location. It engulfed all four of them and swept them along. Two of the group released their ABS backpacks. The one member of the group who was not completely buried alerted the police immediately.

Around ten minutes after the avalanche was released, the person who placed the alarm call located the first of his companions, who was buried 30 cm deep. This victim was uninjured. The other two group members were buried about 1 m deep. The first was freed from the snow masses 30 minutes, the second about 45 minutes after the rescuers arrived. Despite immediately initiating resuscitation attempts, one of the victims died at the scene of the accident; the second person was airlifted in critical

condition to the cantonal hospital in Chur. This second member of the group died that same evening.

Weather and avalanche situation

During the days that spanned the turn of the year, around 30 cm of snow fell in the region. The snowfall was accompanied by moderate winds. Snow drift accumulations formed. On north facing slopes along the main Alpine ridge the snow layering was to some extent unfavourable. However, the weak snowpack fundament did not play a part in this accident. Only the most recently fallen fresh snow and snow drift accumulations of the previous days were released.

The weather was sunny on the day of the accident. Visibility was good.

Extract from the National Avalanche Bulletin for January 3 2012, valid for the region in which the accident occurred:

– *Avalanche danger forecast: Considerable avalanche danger (level 3).*

Avalanche prone locations are to be found, in particular, on wind-loaded slopes in all aspects above approximately 2200 m. Both fresh and older snow drift accumulations can be released easily in some cases. In addition, on the Main Alpine Ridge and the Upper Engadine in particular, avalanches can be triggered from deep layers of the snowpack on north facing slopes above approximately 2500 m. For those venturing off piste, caution and experience in the assessment of avalanche danger are important.

TABLE 1 – Weather conditions in the region where the accident occurred, as measured by manned and automated stations. The indicated figures are mean values (for wind and temperature) and the quantity of fresh snow in 24 hours. The manual readings are taken at 8 am, and the automated measurements refer to a 24-hour period from midnight to midnight.

Date	Air temp. (°C) PMA1 ^a	mean wind strength (km/h)/direction PMA1 ^a	Fresh snow (cm) VMA2 ^b	Fresh snow (cm) 5JU ^c
31.12.2011	-7	20–NW	7	17
01.01.2012	-2	22–W	6	12
02.01.2012	-5	41–W	0	0
03.01.2012	-6	23–N	18	18

^a PMA1: ENET wind station Piz Martegnas 2670 m; distance of 17.7 km.

^b VMA2: IMIS snow station Val Madris, Schwarzseen 2530 m; distance of 8.7 km.

^c 5JU: Observer station Juf 2117 m; distance of 2.6 km.

1. Extract from: *Techel, F., Pielmeier, C., Darms, G., Teich, M., Margreth, S. 2013: Schnee und Lawinen in den Schweizer Alpen. Hydrologisches Jahr 2011/12. WSL Ber. 5: 118 S., Seiten 57 – 60, translation: TTN Translation Network*



FIGURE 1 – View of the track made by the group as they ascended the Juferhorn. The avalanche fracture is visible near the top (photo: Grisons cantonal police, January 3 2012).



FIGURE 2 – The area where the avalanche fractured (photo: Grisons cantonal police, January 3 2012).



FIGURE 3 – General view of the slope showing the ascending track (left) and the avalanche. The group were overwhelmed near the very top of the avalanche path and swept along for several hundred metres (photo: Grisons cantonal police, January 3 2012).

Avalanche data

Avalanche – app. 12.30 pm			
Map Nr.	1276	Fracture depth min. [cm]	30
Length [m]	550	Fracture depth mean [cm]	40
Width [m]	70	Fracture depth max. [cm]	50
Terrain			
Aspect	NE	Slope angle on map [°]	41
Altitude [m]	2820	Type of terrain	open slope
Release information			
Release type	person	Safety distances	no
No. of triggering persons	4	Activity	back-country tour, ascent, skiing
No. of involved persons	4	Tracks	no
Involved person			
1 st person	Injury fatal fatal injured uninjured	fully buried	approx. 45 min.
2 nd person		fully buried	approx. 30 min.
3 rd person		partially buried	–
4 th person		fully buried	approx. 10 min.

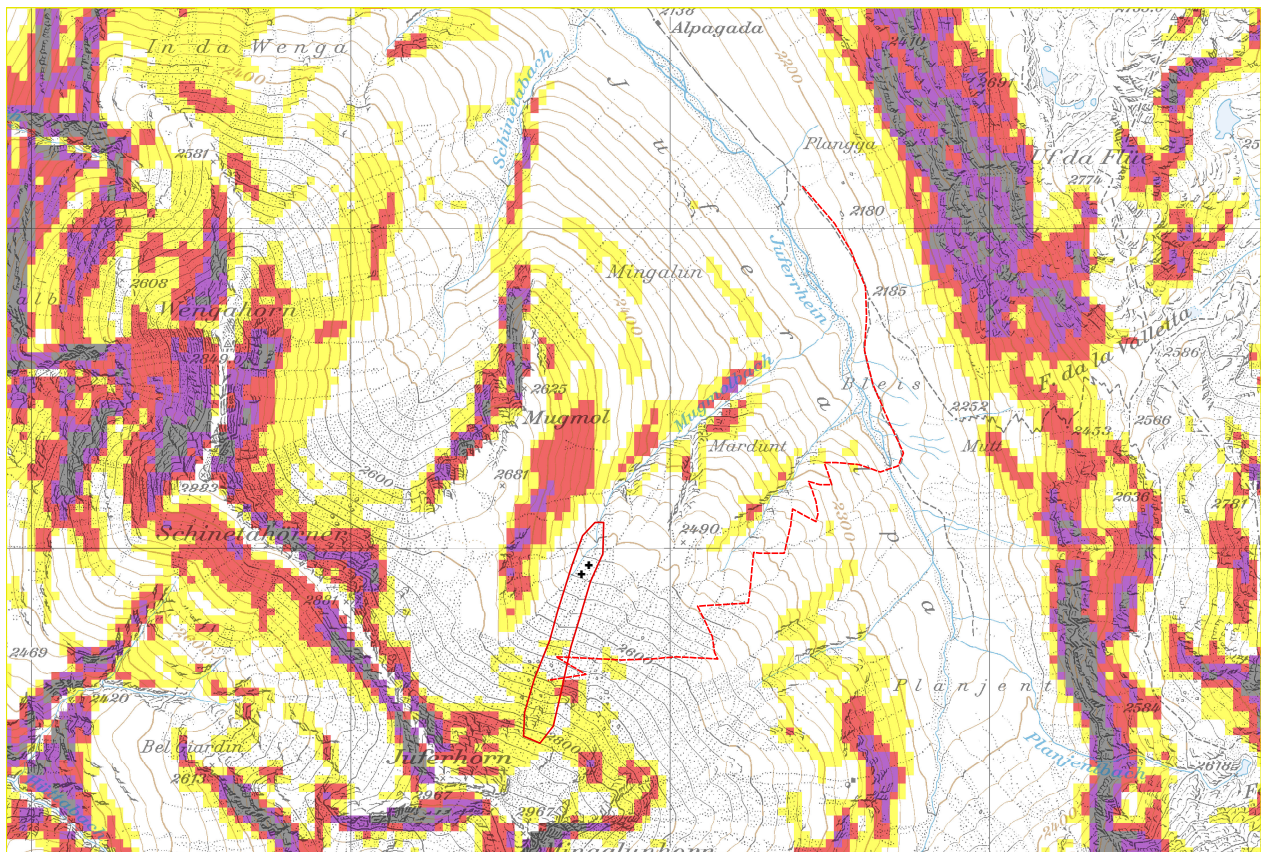


FIGURE 4 – Map section of accident site (1:25,000, national map sheet 1276) showing the approximate route of the ascent (red broken line), the avalanche outline (red), and the places where the victims were found (black crosses). Map reproduced with permission from swisstopo (JA100118/JD100040).

Meierhofer Tälli, Davos (GR), February 17 2012 – Body of missing snowboarder found in avalanche during night-time search.¹

An avalanche in the off-piste territory of the Meierhofer Tälli was reported in the late afternoon. Members of the rescue service conducted a physical search of the area and deployed transceivers. In the absence of any missing person reports, the search was aborted. When the family of an Estonian man reported him missing from their hotel in the evening, a night-time search mission was launched. Around midnight an avalanche dog located the man's body in the avalanche on the Meierhofer Tälli run, from where it was recovered by the rescue teams.

Search and rescue mission

Shortly after 4 pm a tourist reported to the valley station of the Meierhof chair lift (Parsenn ski resort)

that he had observed an avalanche in the vicinity of the Mittelgrat (Fig. 1). He did not actually see the avalanche in motion, however, or know whether any people were in the area at the time. A ranger belonging to the Parsenn rescue service immediately made his way to the avalanche location. He was joined by a second ranger a little later. The two men deployed transceivers, visually scanned the avalanche deposit and listened for signs of life, but without any success. Since no further witness reports had been received, they counted the tracks to the right and left of the avalanche. Whereas the tracks on the slope on both sides of the avalanche tongue could be correlated to individual skiers, at the base of the slope that was not possible because the area had been traversed too many times. The search was called off at around 4.45 pm.

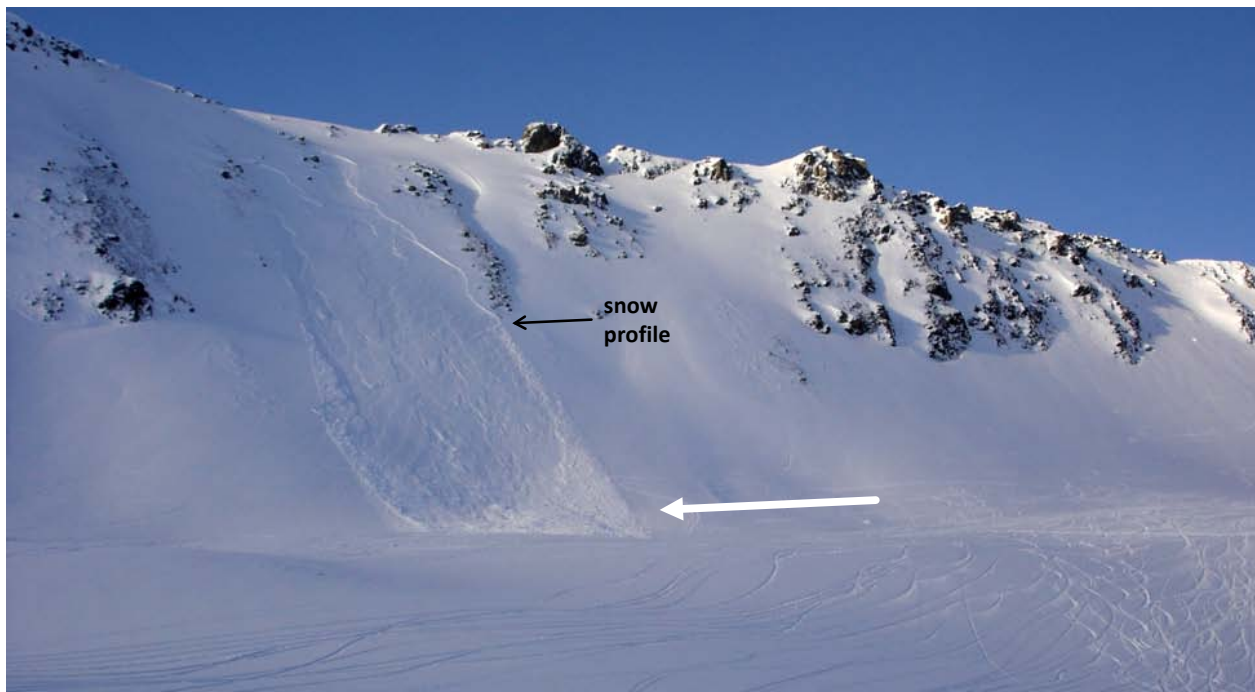


FIGURE 1 – View of the avalanche site where the accident occurred from the valley station of the Meierhof chair lift. The victim approached the slope from the right (white arrow). Two days later a snow profile was taken alongside the avalanche path (Photo: Parsenn rescue service, February 18 2012).

At 6.30 pm the Hotel Seehof reported a missing person to the emergency rescue station of the Parsenn resort. Family members later filed a missing person report with the police. The use of the mis-

sing person's day pass was then traced. It was last registered at 3 pm in the Parsenn ski resort. At 9 pm the family issued the cantonal police force with a search request, and five rangers belonging to the

1. Extract from: Techel, F., Pielmeier, C., Darms, G., Teich, M., Margreth, S. 2013: *Schnee und Lawinen in den Schweizer Alpen. Hydrologisches Jahr 2011/12. WSL Ber. 5: 118 S., Seiten 66 – 69*, translation: TTN Translation Network



FIGURE 2 – Tracks leading onto the slope. The avalanche accident site can be seen in the background. The Meierhof ski run and chair lift are also depicted (photo: Parsenn rescue service, February 18 2012).

Parsenn rescue service were dispatched together with two dog handlers. Inquiries were made in all of the resort's premises serving visitors to the mountains and skiers, but the missing person was not found. The area identified by mobile phone position finding, which did not correspond to the location of the avalanche reported in the afternoon, was searched. At around 10.15 pm the rangers and dog handlers made their way towards the avalanche in the Meierhofer Tälli area. After searching for about 20 minutes, one of the two avalanche dogs indicated the spot where a person was buried. Found at a depth of 1.60 m, the victim was not carrying a transceiver. His body was recovered and transported to Davos hospital by the Swiss air rescue service.

Sequence of events

The victim was snowboarding alone in the late afternoon of February 17 in the resort. His companion had already returned to the valley.

Near the top of run No. 11, the victim is thought to have ventured off-piste and crossed the north-facing slope of the Meierhofer Tälli parallel to the run (Fig. 2). The avalanche was released either by the victim himself (remote triggering) or naturally. No tracks leading onto the slope were found above the avalanche (Fig. 1). Even after the event, it was impossible to establish whether any other persons

were in the vicinity at the time the avalanche was released.

The investigation of the accident conducted by the police revealed that the ski run was properly marked and the avalanche warning light was switched on (indicating considerable avalanche danger).

Weather and avalanche situation

The fresh fallen snow and snow drift accumulations from the days preceding the accident were deposited on top of a weakly bonded, faceted layer. Numerous avalanches were triggered in the Davos region on February 16 and 17; some were released naturally, others artificially (by blasting); still others were released by people.

Two days later, while a snow profile was being taken alongside the avalanche fracture, whumpfung sounds were heard apart from the highly frequented terrain on the north and east facing slopes (Fig. 3).

Extract from the National Avalanche Bulletin for February 17 2012 applying to the region where the accident occurred:

– *Avalanche danger forecast: Considerable avalanche danger (level 3)*

The avalanche prone locations are to be found on steep slopes in all aspects above approxi-

mately 1800 m. Avalanches can be easily triggered by backcountry skiers or freeriders. Remote triggerings can be expected. Naturally triggered avalanches are possible in isolated cases. In outlying terrain away from secured ski runs, the avalanche situation is very delicate and treacherous. A great deal of experience in evaluating avalanche dangers and restraint are imperative.

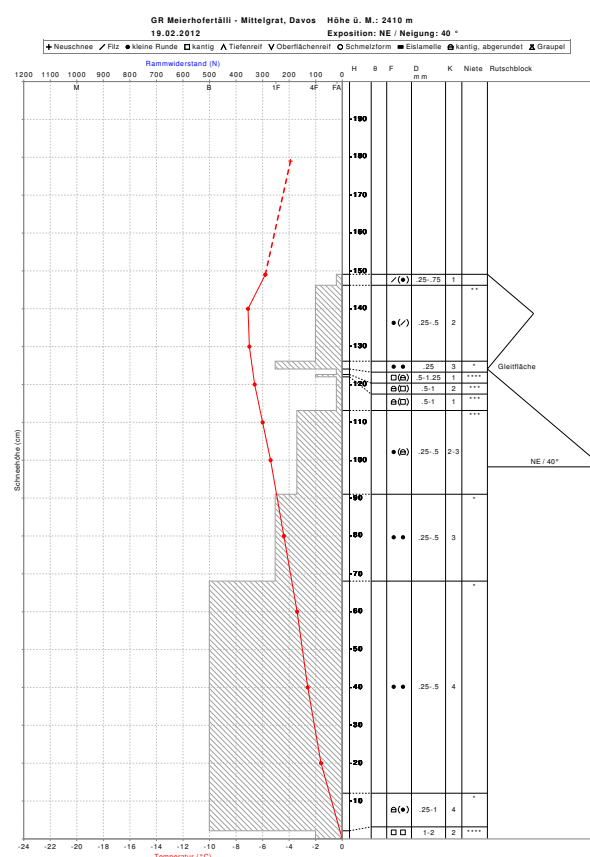


FIGURE 3 – Snow profile taken on February 19, two days after the accident. The weakly bonded layer was faceted.

TABLE 1 – Weather conditions in the region where the accident occurred, as measured by manned and automated stations. The indicated figures are mean values (for wind and temperature) and the amount of fresh snow in 24 hours. The manual readings are taken at 8 am, and the automated measurements refer to a 24-hour period from midnight to midnight.

Date	Air temp. (°C) WFJ1 ^a	mean wind strength (km/h) WFJ1 ^a	Fresh snow (cm) WFJ2 ^b	Fresh snow (cm) 5WJ ^c
14.02.2012	-16	28	0	0
15.02.2012	-13	36	0	6
16.02.2012	-13	35	0	10
17.02.2012	-9	24	64	30
18.02.2012	-6	10	0	2

^a WFJ1: ENET wind station Weissfluhjoch 2693 m; distance of 1.1 km.

^b WFJ2: ENET snow station Weissfluhjoch 2540 m; distance of 0.7 km.

^c 5WJ: observer station Weissfluhjoch 2540 m; distance of 0.7 km.

Avalanche data

Avalanche – approx. 4 pm			
Map Nr.	1197	Min. fracture depth (cm)	20
Length (m)	300	Mean fracture depth (cm)	30
Width (m)	73	Max. fracture depth (cm)	70
Gelände			
Aspect	NE	Slope angle on map (°)	45
Altitude (m)	2480	Type of terrain	Rocky, steep terrain
Release information			
Release type	person	Safety distances	–
No. of triggering persons	1	Activity	off-piste, snowboard
No. of involved persons	1	Tracks	yes
Involved person			
1 st person	Injury fatal	Type of burial fully buried	Duration of burial approx. 7 hours

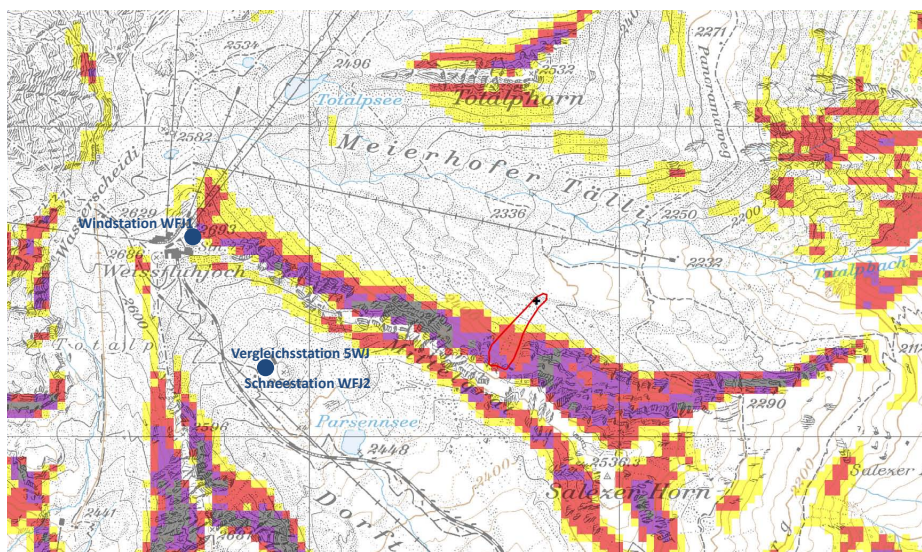


FIGURE 4 – Map section of accident site (1:25,000, national map sheet 1197) showing the avalanche outline (red), the place where the victim was found (black cross), and the manned and automated measuring stations on the Weissfluhjoch (Windstation: wind station; Schneestation: snow station; Vergleichsstation: observer station). Map reproduced with permission from swisstopo (JA100118/JD100040).

Stanserhorn, Stans (NW), February 24 2012 – Excavator driver buried by full depth snowslide while clearing snow.¹

A full-depth snowslide released while clearance work was taking place to remove the avalanche deposits of the previous day from the forest road leading to Bluematt. The posted lookout alerted the excavator operator, who leapt from his cab but was unable to reach safety in time. He was buried more than 2 m deep in the avalanche; around 75 minutes elapsed before his body was recovered by rescuers.

Sequence of events and rescue mission

On the morning of February 24 the operations manager and two employees of the Stans Public Utilities cooperative set off on the forest road towards Bluematt (1200 m). Their assignment was to clear away avalanche deposits of the previous day from the forest road so that they could subsequently carry out work at the location of the second pylon of the Stanserhornbahn cableway.

The gang were driving an excavator and two goods vehicles. At around 10 am they began the avalanche deposit clearing operation in the Grosslangzug section of the track. While one of the gang was clearing the road with the excavator, another was posted on the avalanche cone to observe the slope. The third member of the gang was in a safe place about 50 m away when, at around 10.15 am, a full-depth snowslide was suddenly released about 200 m further up (Fig. 1). The lookout shouted "Avalanche!" to his colleague in the excavator before quickly seeking cover himself. The excavator operator leapt from the cab in order to escape the danger area as well. He was caught by the snow masses immediately alongside the vehicle and buried to a depth of around 2 m.

In the absence of any avalanche emergency equipment, the victim was not located until an avalanche dog arrived at the scene; he was uncovered after a period of about 75 minutes. Despite having access to a pocket of air, he had suffocated.

Weather and avalanche situation

There had been no precipitation on the three days preceding the accident. The zero-degree level was rising significantly in altitude, from approximately 500 m on February 20 to approximately 2700 m on February 24 (Fig. 2). On the night before the accident the skies were clear. The profile taken on a north facing slope the day after the accident indicated a partly moist snowpack (Fig. 3).



FIGURE 1 – Rescuers uncovering the snow clearing vehicle on the forest road to Bluematt on the Stanserhorn in canton Nidwalden (February 24 2012, photo: Nidwalden cantonal police).

Extract from the National Avalanche Bulletin for February 24 2012, valid for the region in which the accident occurred:

– Avalanche danger forecast:

Moderate danger of dry avalanches (level 2).

The avalanche prone locations are to be found primarily in southwestern to northern to southeastern aspects above approximately 1600 m. The major peril stems from older snowdrift accumulations which have generally been blanketed over by last week's snowfall. These avalanche prone locations are discernible only with difficulty. Avalanches can still be triggered by a single backcountry skier or freerider in isolated cases. A cautious route selection, as well as maintaining distances between persons when ascending the mountainside and descending singly are important.

– Danger of moist and wet avalanches.

Through solar radiation and the daytime warming cycle, the danger of moist and wet avalanches is expected to escalate significantly over the course of the day. On the Main Alpine Ridge and northwards thereof, danger Level 3 (considerable) will be reached. On east, south and west facing slopes below about 2400 m in par-

1. Extract from: Techel, F., Pielmeier, C., Darms, G., Teich, M., Margreth, S. 2013: *Schnee und Lawinen in den Schweizer Alpen. Hydrologisches Jahr 2011/12. WSL Ber. 5: 118 S., Seiten 70 – 72*, Translation: TTN Translation Network

ticular, small sized, in isolated cases medium sized naturally triggered avalanches can be expected. Such avalanches can be triggered even by a single backcountry skier or freerider. Tours in outlying terrain should be brought to a close early

in the day. In addition, below about 2400 m, full depth snowslides are possible which can, in isolated cases, place exposed sections of transportation routes at risk. Caution is urged below glide cracks.

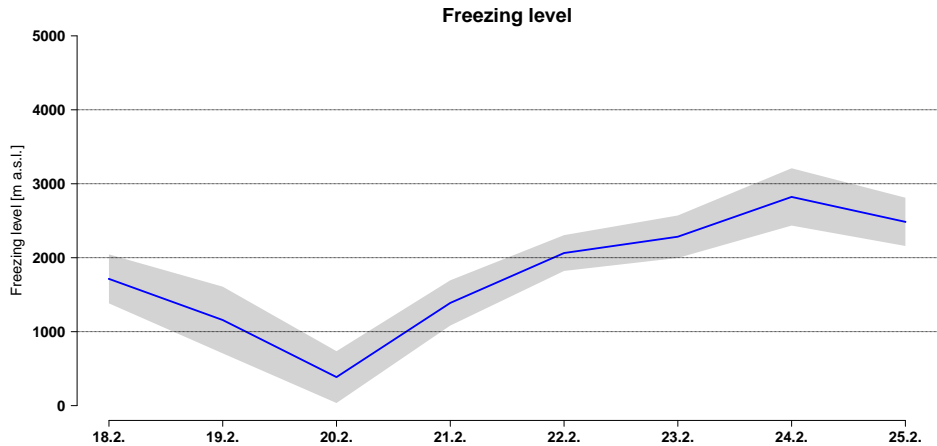
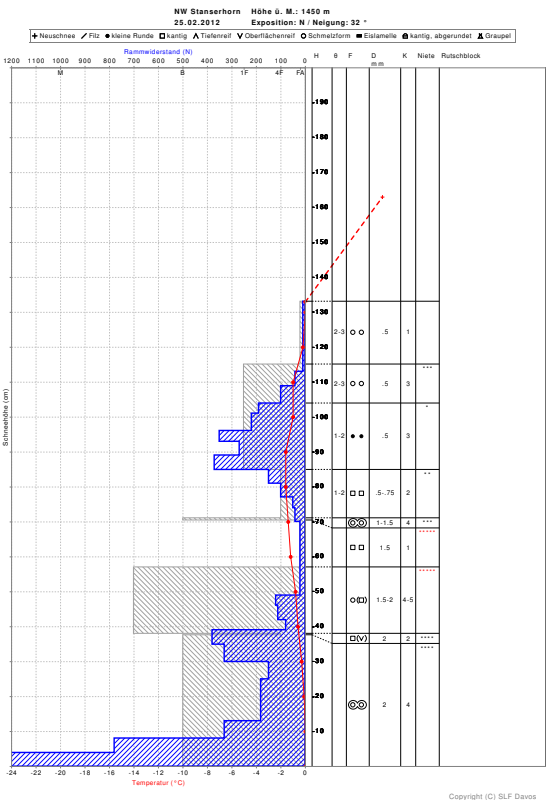


FIGURE 2 – Change in zero-degree level between February 18 and 24 2012. On February 24 the zero-degree level rose to 2400 m and then to 3200 m. The zero-degree level was calculated from data collected by 11 automated ENET measuring stations distributed throughout the entire Swiss Alps assuming a temperature drop of 0.6 degrees per 100 m altitude (mean: blue line, grey area: dispersion of values recorded by the 11 stations).



Remarks

Winter 2011/12 was characterised by exceptionally high full-depth snowslide activity. Since the snowpack depth was above average over an extensive area, medium-sized and sometimes large full-depth snowslides were common. In particular during the period from December 2011 until the end of February 2012, full-depth avalanches occurred at every time of day and night. The snowpack was often moist only at the interface with the ground and otherwise mostly dry. Wet and full-depth avalanche activity was especially high as the snowpack became increasingly moist on February 24/25 and at the beginning of March. Thereafter the full-depth avalanche activity returned to a greater dependence on the time of day. Since this avalanche accident occurred while the victim was at work and various persons were responsible for his assignment, the public prosecutor's office initiated a criminal investigation. Two persons are being prosecuted but the case is still pending as of the date of the present report.

FIGURE 3 – Snow profile taken at 1450 m on a north facing slope the day after the accident. For safety reasons, it was taken on an adjacent slope in a similar aspect, but at an altitude approximately 200 metres higher. At the profile site the snowpack was still dry to some extent, but to some extent already moist.

TABLE 1 – Weather conditions in the region where the accident occurred, as measured by manned and automated stations. The indicated figures are mean values (for wind and temperature) and the quantity of fresh snow in 24 hours. The manual readings are taken at 8 am, and the automated measurements refer to a 24-hour period from midnight to midnight.

Date	Air temp. (°C) PIL ^a	mean wind strength (km/h)/direction PIL ^a	Fresh snow (cm) TIT2 ^b	Fresh snow (cm) 2RI ^c
20.02.2012	-11	19–N	23	9
21.02.2012	-4	11–E	0	0
22.02.2012	0	17–NE	0	0
23.02.2012	0	15–SW	0	0
24.02.2012	4	8–W/NW	0	0

^a PIL: ANETZ station Pilatus 2106 m; distance of 6.1 km.

^b TIT2: IMIS snow station Titlis 2140 m; distance of 17.4 km.

^c 2RI: Observer station Rigi-Scheidegg 1640 m; distance of 16.1 km.

Avalanche data

Avalanche - approx. 10.15 am			
Map nr.	1170	Min. fracture depth (cm)	30
Length (m)	200	Mean fracture depth (cm)	40
Width (m)	50	Max. fracture depth (cm)	50
Terrain			
Aspect	N	Slope angle on map (°)	35
Altitude (m)	1340	Type of terrain	Forest aisle, bowl
Release information			
Release type	natural	Safety distances	–
No. of triggering persons	–	Activity	Maintenance
No. of involved persons	1	Tracks	–
Involved person			
1 st person	Injury fatal	Type of burial fully buried	Duration of burial 1 hour 15 min.

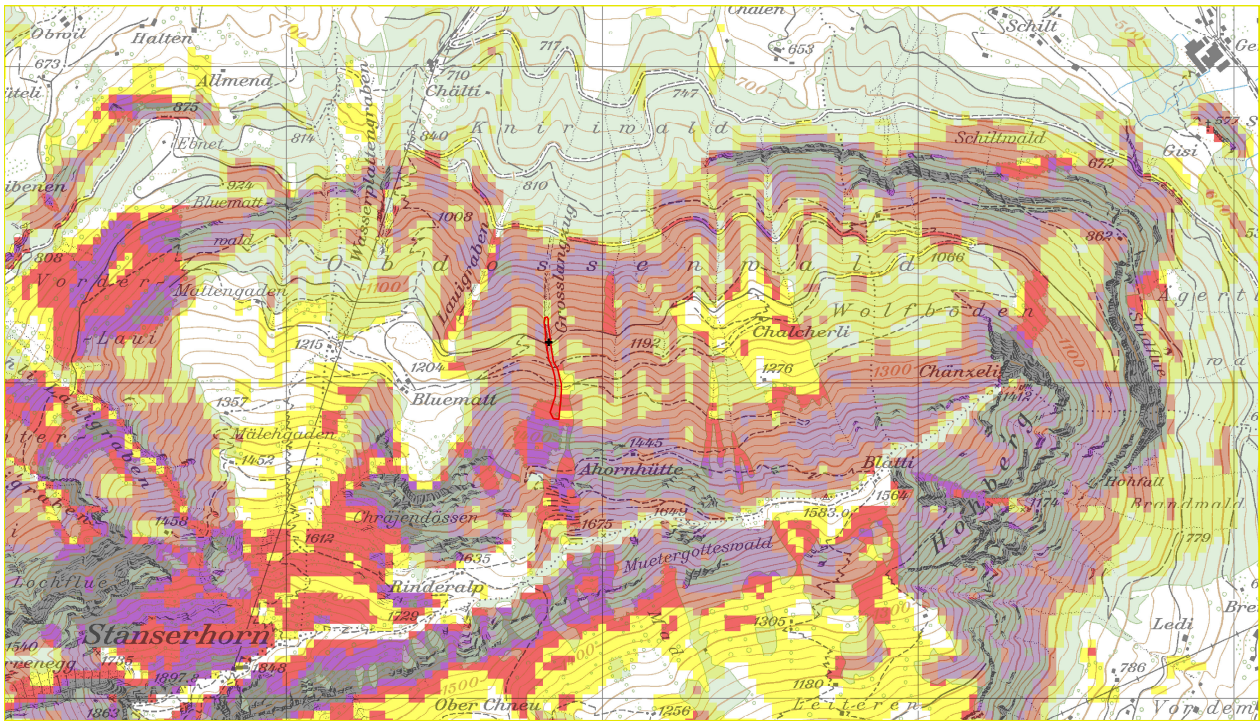


FIGURE 4 – Map section of accident site (1:25,000, national map sheet 1170) showing the outline of the avalanche (red) and the place where the victim was found (black cross). Map reproduced with permission from swisstopo (JA100118/JD100040).