Incidents and near-misses in mountain sports

The first lessons and suggestions for prevention

Maud Vanpouille
Bastien Soulé
Eric Boutroy
Brice Lefèvre
Véronique Reynier
Guillaume Routier
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This study was conducted by a research group

Scientific study manager
Bastien Soulé, sociologist
Lyon 1 university, Laboratory of Vulnerability and Innovation in Sport

Maud Vanpouille, researcher
Lyon 1 university, Laboratory of Vulnerability and Innovation in Sport

Brice Lefèvre, sociologist
Lyon 1 university, Laboratory of Vulnerability and Innovation in Sport

Eric Boutroy, anthropologist
Lyon 1 university, Laboratory of Vulnerability and Innovation in Sport

Véronique Reynier, psychologist
Lyon 1 university, Sport and Social Environment Laboratory

Guillaume Routier, sociologist
Lyon 1 university, Laboratory of Vulnerability and Innovation in Sport
Preface

The first study of the accidentology of mountain sports\(^1\) was published in 2014, with support from the Petzl Foundation. This study was based on all the sources available in France, and additional information from other countries concerned by similar leisure activities; it confirmed certain theories concerning the profiles of victims and accident mechanisms. It also helped, by providing factual supporting evidence, to offer some perspective and a different interpretation of this accidentology. By underlining the diversity of data provided by the prevention, rescue and medical teams involved with accident victims, this report identified the limits of these sources: produced on the basis of multiple references, focussing on different objectives, presenting a limited number of descriptive elements, the information in question proved difficult to read for anyone attempting to optimise mountain sport accidentology. The report started with a promising orientation: a more plus proactive approach to incident and near-miss reports, following the example of ANENA, which has been in operation for 15 years in France, or other pioneer sites in the USA and Switzerland\(^2\). These initiatives have opened the way to an approach that the SERAC database intends to structure and perpetuate, with the initial support of the Camptocamp community, Petzl Foundation and the expertise of a research team\(^3\). A little more than 2 years after the 2014 report was published, this paper presents the first results obtained from SERAC, proposing an interpretation and suggesting basic perspectives for preventative actions.

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2. Two systems to gather information concerning near-misses have been set up over the past few years: www.alpinenearmiss.org (initiated by Cory Jackson in the USA) and www.alpinesicherheit.ch (a Club Alpin Suisse initiative).

3. Expertise attested by scientific publications highlighting the preventive perspectives offered by incidentology (in Safety Science or Revue Européenne de Management du Sport, for example).
On October 31 2016, after a trial and preliminary launch period of 11 months, the SERAC database comprised of 184 reports. This is a lot, considering the recent nature of the tool and the performance of other experience sharing systems (Alpine near-miss survey and Alpinesicherheit, cited in the preface, each contain fewer than 100 reports after three years’ existence).

The database is therefore large enough to enable us to draw up an initial exploratory inventory of the trends revealed in terms of accident and incident types for each activity, the seriousness of these events and the profiles of the people affected; we can also see some of the most common accident-creating mechanisms.

These first lessons may recall situations experienced by us all, which means that the resulting recommendations are more likely to affect the way in which we approach and deal with hazardous situations. However, these descriptions and interpretations must be addressed with a certain degree of caution: the analyses proposed depend largely on the content of the reports registered and the level of detail provided. They cannot be considered representative of all incidents and accidents occurring during mountain sports. It is therefore important to avoid excessive generalisation on the basis of our sample, which remains limited, and the filter constituted by the particular profile of the members of the Camptocamp community. However, these analyses reveal certain trends that could be consolidated as the number of reports submitted gradually increases.

1. https://www.camptocamp.org/articles/697210/fr/base-serac-de-recits-d-incidents-et-accidents
How is the SERAC database used?

1/ Which activities are best represented?

The database contains 90 reports regarding ski touring (i.e. almost half of all testimonials), 39 climbing, 34 mountaineering (snow, ice and mixed), 23 Alpine climbing, 6 ice climbing and 6 hiking. There are very few reports on ice climbing and hiking and none whatsoever concerning snow-shoe excursions. The sporting profile of the members of the Camptocamp community, which is mainly focussed on ski touring, various forms of mountaineering and rock climbing, may explain this low level of representation. Ice climbing is also an activity practised by a relatively small population, and there are other websites for sharing information on conditions (e.g. www.icefall-data.org).

![Graph showing percentage of reports registered in SERAC for each activity](image)

**Fig. 1 /** Percentage of reports registered in SERAC for each activity

**Source:** analysis of the reports registered in SERAC on October 31 2016 (n=184)

**Interpretation:** 49% of incident or accident reports in SERAC concern ski touring (the total exceeds 100% because one report may concern several activities)

2/ Contributor profiles

40% of respondents are aged between 26 and 35 and 25% between 36 and 45. There are fewer under 25s and over 46s (13% between 16 and 25, 19% between 46 and 55 and only 3% over 56). 84% of respondents are men.

Most people submitting a report claim to have a high level of autonomy in the activity related to the reported accident or incident: 40% consider themselves as being capable of accompanying less experienced participants in their activity.

1. A single report can concern more than one activity.
56% participate in the activity more than 15 times per year. The category most active in SERAC is men aged between 26 and 35, relatively experienced, experienced and even expert in their activity. 25% of SERAC contributors fall into this category (46 / 184 reports).

Fig. 2 / Age of SERAC contributors

Source: analysis of the reports registered in SERAC on October 31 2016 (n=184)

Interpretation: 40% of contributors to the SERAC database are between 26 and 35 years old

3 / Typology of the events reported

For all activities, avalanches represent 39% of main events, a falling person and/or roped party 36% and rock or ice falls 23%.

Fig. 3 / Main types of events reported in SERAC

Source: analysis of the reports registered in SERAC on October 31 2016 (n=184)

Interpretation: 39% of incident or accident reports in SERAC concern avalanche events.

The scenario described sometimes includes a sequence of events. For example, in mountaineering, if the main event is a fall, it may not cause any actual injury, but result in a situation that is difficult to manage in a location that is difficult to access; in ski touring, the main event may be the avalanche, but it causes a fall from a cliff and/or difficulties for the rest of the group to provide assistance...

63% of reports concern incidents and near-miss. Some incidents reveal the barriers (preventative or protective measures) that were implemented to prevent the situation from developing into an accident. Such situations can even be considered as "minor successes", in that a solution was found in a critical situation.

The large proportion of situations that did not degenerate into accidents, partly due to good decisions and foresight, suggests a certain ability to identify and analyse situations, enabling preparation and rapid reaction "just in case".

2. An accident scenario may concern an accident or an incident.
How is the SERAC database used?

**Accident, incident, near-miss: what exactly are we talking about?**

SERAC was initially designed to gather information on events that had no physical consequences or only minor impacts. However, three types of situations are reported, classed below in decreasing order of seriousness.

An **accident** is an event that causes one or more physical injuries (with or without intervention by rescue teams), regardless of the seriousness of the injury.

An **incident** is an event which does not cause any injury, but which could have had serious consequences in slightly different circumstances or if people had behaved slightly differently. E.g.: fall or avalanche with no physical consequence, nearby rock fall, etc. Only 5% of the reported avalanches resulted in buried victims; these may be classed as either incidents (no physical impact) or accidents (physical consequences of various kinds).

A **near-miss** is a situation in which no specific event occurs, but all the conditions were present and the situation could have deteriorated into an incident or accident (a near-miss). E.g.: getting lost, not having the equipment necessary for a tricky passage, realising that a knot was not correctly tied at the last moment, etc.

The reports show that this is one of the main factors that prevent accidents and incidents from occurring and/or can attenuate their consequences. For example, in a ski touring situation recognised as being potentially dangerous, by activating a high level of vigilance, spacing out the group members and watching out for each other, the consequences of a possible avalanche may be attenuated (avoiding multiple buried victims, possibility of rapid assistance if an avalanche actually occurs).

**Humility remains fundamental**: it is sometimes pure luck that enables an accident to be avoided. To use the avalanche example again, the skiers’ vigilance, responsiveness and even expertise on skis are often cited as reasons for “not getting caught”. This fairly common analysis may be questioned since it reflects an **under-estimation of the danger that an avalanche actually represents** (volume, speed, power, etc.), and a deceptive feeling of control experienced by skiers faced with such events (over-estimation of their ability to avoid it).

**Prevention must prevail** (avoiding occurrence of the event) rather than counting on the **illusion of our ability to counter or even control the forces of nature**. Some reports even suggest an alarming form of trivialisation of avalanche dangers amongst certain skiers with strong technical expertise.

**Few reports describe turning back in a situation recognised as being dangerous**. Feelings of shame or “defeat” related to the intervention of specialist rescue teams (perhaps due to a too difficult technical section of the route, injury, fatigue or loss of equipment) are sometimes described. It would be interesting to have more specific details to find out if the tendency to delay calling for help constitutes a contributory factor of accident scenarios.
Most events related to ski touring concerned avalanches (63%), but only 5% resulted in skiers being buried.

1 / Factors contributing to avalanche events

In most cases, the accident or incident results from a biased assessment of the risks. This leads to imprudent and/or inadequate decisions with respect to the group’s skills and experience. The reports reveal that pressure of various kinds interferes with the assessment, even though knowledge of the weather and terrain enables most skiers to analyse the danger properly.

Just over a third of all avalanche reports describe processes that lead to a feeling of safety and supporting a decision. For example, an avalanche risk (BERA) of level 2 (moderate) or even 3 (considerable) is considered reassuring in 15% of the reports; the assessment of actual risk once in the field then takes second place.

The reassuring effect of the avalanche bulletin at Crête des Echarennes

“We had underestimated the mild conditions that were mentioned in the weather forecast and, on top of that mistake, we were reassured by the level 2 risk” (The route is a trap in poor conditions.) (Crête des Echarennes: N side – from Désert en Valjoufrey)

• The bad advice of experience

If someone knows the terrain (possibly in summer, or different snow conditions), if there are signs of passage or a hard freeze, this may lead to reduced caution with respect to avalanches and a failure to (re)assess the risks on site.

Trapped by habit on Mont Fromage

“We didn’t pay enough attention to the strong winds that were shifting the snow, because we often do this itinerary when the avalanche risk is high. Basically, we fell into the trap of a route we believed to be risk-free” (Mont Fromage – Tricotage)

1. This element is based on the bias of social proof: the tendency to consider behaviour adopted by other people as being acceptable (McCammon, 2004).
If the first part of the excursion is problem-free, a sudden improvement in weather conditions or the fact that the first member of the party experienced no difficulties are also contextual elements that can sometimes result in less vigilance.

This type of testimonial often reflects the bias of familiarity, the tendency to consider behaviour as being acceptable if we have already behaved in a similar manner (without consequence) in the past; according to McCammon (2002), 69% of avalanche accidents occur in sites known to the victim. Being in a familiar place or situation may mean that we fail to assess the level of danger.

Six reports also describe a false feeling of safety due to the presence of trees or rocks on a slope, or a small amount of snow, again (wrongly) interpreted as being favourable signs, whereas they may actually indicate instability. Improving information relating to certain misconceptions or traditional beliefs regarding avalanches may be a good place to start.

The bottom line

Based on the written reports, it appears to be important to recall the extremely dangerous nature of an avalanche, even if it appears to be a small one, and a few figures on the volume of snow involved and/or the speed of the avalanche. Munter (2006) writes, “most skiers vastly under-estimate the volumes and weights of snow involved. Furthermore, small slabs of snow can actually be fatal. A mini-slab, measuring 20 x 30 x 0.35 m, depending on the type of snow, can weigh between 20 and 40 tonnes. A fraction of this weight is enough to bury someone, potentially killing them.”

The ambiguous nature of experience is thus revealed: it often means the development of good assessment skills, but also seem to go hand in hand with greater risk-taking due to increased self-confidence, trivialisation of danger and the weight of certain misconceptions.

NB: the recommendations given throughout this report are not intended to be lessons, but are drawn directly from the contributions and experiences shared in SERAC.
• When attention ceases to be focussed on the essential

Attention shifting onto something other than the avalanche risk is mentioned in 20% of the reports. Enthusiasm for the descent causing people to “forget” the safety rules is the most common reason, but it may also be due to a technical difficulty that monopolises the attention (dealing with wind, looking for a route, a difficult passage, etc.), and even thoughts that have nothing to do with the excursion or the activity (professional concerns, family tensions, etc.).

Fatigue, mentioned in 18% of reports, often at the end of the excursion but also built up over previous days, is another factor that affects the risk assessment bias.

**Enthusiasm for the Petit Van descent**

“I let myself get carried away by the elation of the descent and left the couloir to ski on an untouched slope on the right side. (…) Flying through snow, with powder up to my ears, leaving my tracks on the untouched snow made me forget all the rules of caution” (Avalanche in the NW couloir of Petit Van)

**Unrelated concerns at Trou du Mont-Blanc**

“A fair bit of accumulated fatigue, what with work and setting out early for the excursions of the previous days… a quality problem discovered at 11 o’clock last night (never open work emails at such times!!), difficulty getting up, no Nutella left for breakfast, weather not as good as the forecast, a missing hat… it was never going to be a great morning (…) I just didn’t think about the risk associated with the situation in which I found myself, or of the fact that I was well away from the standard I impose on myself when setting out alone” (Slab avalanche in the NW combe of Trou du Mont-Blanc)

• Group pressure or personal pressure

A certain form of pressure is described in 16% of reports: pressure from the rest of the group who want to go on, the pressure of time causing rushed decisions, and even pressure due to earlier sacrifices (taking a day off, a long car journey, etc.). Such elements make it difficult to decide to turn back. Inadequate communication within the group is another factor often identified: no clear leadership, tacit reliance on the others, finding it hard to express personal doubts, etc.

**Persuaded by a member of the group at Petit Van**

“A. wanted to go up to Les Vans: the snow looked quite good over there, you could see the tracks. After a short debate, I gave in, after all, the normal route is not steep and already showed plenty of tracks (…) A. wanted to come down via the NW couloir, I said no, that this is often the side where slabs form, but since others had gone that way and it looked like the skiing was good, I ended up giving in” (Avalanche in the NW couloir of Petit Van)
• **Too good to miss**

The bias of scarcity is the tendency to give disproportionate value to opportunities seen as being rare or hard to come by. This could explain why people expose themselves to danger in a number of cases: not turning back, overriding importance of the initial goal, etc.

**The appeal of a good descent** and, more generally, excessive motivation for a mountain excursion are mentioned in 16% of reports. Such elements tend to weigh the balance in favour of the least prudent option, or the option offering the best snow quality, even if the decision-maker should be able to identify or predict the associated risks.

**Excessive motivation in Avalon couloir**

“Too motivated. Not enough snow-ice excursions during this crappy winter, and after a summer ruined by a bad back, I was really motivated to get another one in before spring (March 20 being the first day of spring). So, «negative» motivation (dangerous need to take «get my own back» on time), because it made me ignore the dangers (avalanche risk)” (Fall in Avalon couloir, Roc des Isards)

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• No real alternative

**Inadequate preparation of the itinerary** only appears in 8% of cases. People generally study the initial route and associated risks. However, a **route change during the excursion** is relatively common (16% of cases reported); in this case, the second or even third option is often inadequately prepared, with consequences on times, orientation, slope gradients, etc.

• Presence of other groups: a risk factor

The unplanned **gathering of two groups**, which complicates both communication and the risk management strategy (gaps between skiers, progression from one safe spot to another), is mentioned in a number of reports.

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**Rush hour at Punta Alta**

“I was the last of our group, having stopped to rope a companion who was finding the slope a little steep or the snow too hard on the ridge. There was a Spanish group behind us, who were obviously finding it hard to respect the spacing rules. They must have thought that if 7 people could get through, it would hold OK for them” (Avalanche on the N slope of Punta Alta)

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**2/Why do people ignore the warning signs in avalanche-prone areas?**

In many cases, **the risk is detected**, but the **diagnosis is impaired**. The time factor is often decisive and the pressure of having to decide quickly exacerbates this bias by pushing people to use cognitive short-cuts, choosing the **most efficient solution from a mental point of view**.

When faced with a threat, a person generally goes through the following process: identification of danger **Indicators** (alarm signals) enabling **Detection of a hazardous situation**; the person then decides upon a **Diagnosis**, before making a **Decision** based on this diagnosis, and **Responds** by taking action (IDDDR) (Bellamy & al., 2015). Each stage of the process is subject to different kinds of **bias and influences**. The person often makes an initial analysis, which correctly identifies the danger, then, for various reasons (group pressure, summit fever, the appeal of a great descent, etc.), he comes to a diagnosis that minimises the risk in order to **justify the decision to go on, in spite of his first analysis**. Preferring to concentrate on the “positive signals” that support this diagnosis, the person tends to **block out the less favourable indicators that go against his analysis**. In this case, he may look for “reassuring” indicators to confirm his decision: the presence of tracks, favourable terrain (rocks, trees, snow cover, etc.), a comforting avalanche risk level, good knowledge of the route, presence of other groups, etc. The “commitment escalation” is a similar factor: giving up a course of action may be difficult even when the facts clearly indicate that this is the right thing to do. In other words, it is never easy to say “stop”, because this means acknowledging that you made a mistake, that you probably should not have come this far.

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5. Resilience Success Consortium, Success in the face of uncertainty, Safera (12), www.resiliencesuccessconsortium.com/heading Resources
Although our response to risk is liable to be inadequate, this does not mean that we do not take safety measures (gaps between skiers, increased vigilance, spotting of escape routes, etc.), which may ultimately attenuate the consequences if an avalanche does occur.

This is where the consistency bias kicks in, directing us towards decisions that are in line with previous decisions. Changing the objective or turning back after a new risk assessment for example, are decisions that are less “comfortable” and more difficult to make than deciding to go on.

The bottom line

The reports submitted suggest that, in a hazardous situation, it is important to be aware of the biases identified by McCammon (familiarity, consistency, scarcity and social proof) because they appear to influence the decisions made when facing danger, particularly by experts.

3 / Factors contributing to falls while ski touring

After avalanche events, skier falls are the most common events, representing 18% of reports, falling into a crevasse 6% and rock falls 2%. Not surprisingly, the consequences of 50% of the falls reported were aggravated because they occurred on a steep slope and/or in a couloir. They often resulted in the victim “rolling” to the bottom of the couloir. However, 56% of ski falls did not cause any injuries and remain in the incident category.

Two essential factors contributed to these falls: a descent itinerary that was too difficult for the skiers' abilities (under-estimation of the difficulty of a slope and/or over-estimation of the skiing abilities of group members); incorrect assessment of snow quality (the skier was expecting soft snow, but ended up on “crusted” snow, soft snow topped with ice).

In 21% of cases, over-confidence or a lapse of attention were reported after an initial easy part, a first skier passing without difficulty, or the feeling of having already overcome the main difficulties.

Finally, fatigue at the end of an excursion contributed to the occurrence of the fall in 14% of cases.
The types of recurrent events in the mountaineering (snow, ice and mixed), Alpine climbing and climbing categories are similar; the processes leading up to the accidents or incidents are also alike, with a few rare exceptions, which is why they have been grouped into a single category.

A climber’s fall is the main event in 47% of cases, followed by rock or ice falls (34%), and a physical failing in 11% (acute mountain sickness, fatigue, hypoglycaemia, etc.). Borderline situations while abseiling (last minute realisation that the abseil was not correctly set up) or late return from an excursion are also mentioned, but are not as common.

![Fig. 4 / Main types of events in mountaineering and climbing](image)

**Source:** analysis of the reports registered on SERAC on October 31 2016 (n=184)

**Interpretation:** 11% of incident or accident reports concerning mountaineering and rock climbing refer to events due to a physical failing

1 / Main factors contributing to the fall

- **Over-confidence and a premature lapse of concentration**

31% of fall events mention over-confidence following a section completed easily or a lapse of concentration after having passed the main difficulties (on the way down, after a technical section). Fatigue, at the end of the excursion or accumulated previously, is cited in 15% of cases.

**Fatigue and a drop in vigilance at Grand Pic de Belledonne**

“I think that the wrong decision I made regarding my crampons and my lack of concentration, which caused the slip, were partly due to a state of serious fatigue, accumulated over the previous week. I ignored several signs of distraction, probably excited to be in the mountains after three weeks without” (Grand Pic de Belledonne, fall on the way down Col de la Balmette)
• Confirmation of well-known risk factors

21% of falls are explained by rock falls or instability (a hold coming away/ loose rock). 18% of reports mention the failure of a protective element (piton), anchor (in-place trad climbing anchor, spikes, slings, pitons) or an incorrectly installed abseil (fall at the end of the rope). Finally, itinerary mistakes, bringing the person into unstable terrain or for which he did not have the required technical expertise, are only cited in 5% of cases.

However, we do not have enough mountaineering and climbing fall scenarios to enable a more detailed analysis of the contributory factors and identification of progress areas. One of the challenges facing the SERAC database will be to build up a sufficient corpus of reports to identify recurrent configurations and to consolidate the analysis.

2/ Seriousness of falls and attenuating factors

Mountaineering or climbing falls, unlike avalanche events, often cause physical injuries. Only 30% of the falls reported had no physical consequences (compared with 95% of avalanches reported), and 21% of the falls resulted in the person being unable to do the activity for more than three months.

In 13% of cases, the ability to manage the post-fall situation alone was a factor attenuating more serious potential consequences: expertise in rescue techniques or being able to go back down a route even when this was not planned, the ability of the rest of the roped part to manage the descent, the victim’s ability to finish the route or go back in spite of the injury, often enabled secondary accidents to be avoided.
One area for improvement is mentioned in certain reports: *announcing the hazards identified, and the safety and protective measures implemented* to make sure that all the members of the group are informed and aware of the situation (for example, when setting up an abseil: “prussik loop in place, karabiner gate closed properly, be careful, there’s no knot at the end of the rope”).

### 3 / Factors contributing to rock or ice falls

In just over one third of reports, the rock or ice fall is due to the number of people on the route and is triggered by a party higher up. This observation confirms the truth of a recommendation known to all mountaineers and climbers: take the road less travelled. In 11% of cases, an itinerary mistake brought the party into unstable terrain.

### 4 / Seriousness and attenuating factors of rock and ice falls

Although a large number of rock or ice falls were reported for mountaineering and climbing excursions, **only 7%** of the reports for these activities **involved the person actually being hit by a rock or block of ice**.

11% of rock fall reports state that the **climber or belayer being outside the line of fall** meant that no-one was hit and/or suffered serious consequences. It is also interesting to note that a rock fall can be interpreted as an **alarm signal**, leading to a decision to turn back or to call for help.

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**The bottom line**

These results confirm a trend that was already mentioned in the 2014 report: **incidents and accidents do not usually happen in the most difficult or demanding areas**.

Respondents often indicate that **routine precautions** (testing and reinforcing anchors when trad climbing, testing holds before using them, double-checking equipment between climbers before starting the route, double-checking or announcing the actions taken, etc.) **that could have prevented and/or attenuated the accident were not always taken**.
These lists of contributing factors enable identification and possibly action in the various areas of the factors (environmental factors, knowledge, group-related factors, expertise in safety operations, level of vigilance, responsiveness, expertise in rescue operations, etc.). However, it is important to remember that one contributing factor alone is rarely enough to cause an accident. The facts indicate that a combination of interacting factors results in a situation in which one final failure may prove critical.

Interpretation is complex, because there are many inter-connected contributing factors. It is difficult to separate these ingredients and to class them in order of importance.

This complexity, which is sometimes expressed in the reports submitted, is what makes some reports so valuable. It highlights the benefits of sharing such experiences to improve our understanding of the inter-connected nature of the causes of mountain accidents. Furthermore, incidents – which represent the vast majority of cases in this database – reveal the value of the barriers implemented to avoid the accident and/or attenuate its consequences.

1 / Detailed example of a report

This avalanche report registered in the SERAC database illustrates the complexity of decisions made in avalanche-prone sites.

A number of the aforementioned factors and decision biases appear in this report and they are clearly related. This scenario can be illustrated in a graphical form for more clarity, although it is not intended to classify the factors in any order of importance.

See on next pages
Avalanche in the NW couloir of Petit Van

It was the first outing of the season, the skiers couldn’t wait to get their skis into all this fresh snow. In Chamrousse, you could see the ridges smoking and I told myself it was a day to stick to the slopes, which were still closed (particularly since there still wasn’t a huge amount of snow in the mountains).

As far up as the cross, the Vans valley was pure white and looked to have good snow cover. A few tracks were already visible. The ridges were still smoking with snow that was presumably settling on the N sides; I said to myself (and said) that it really wasn’t a good day to ski there.

On the descent to Lacs Roberts, the snow was really good wherever the wind had left it undamaged.

A. wanted to go up to Les Vans: the snow looked quite good over there, you could see the tracks. After a short debate, I gave in, after all, the normal route is not steep and already showed plenty of tracks.

In Combe des Vans, the snow on the right side was hard (all the fresh snow had been swept away), the left was powder. We could see several people headed down the NW of Petit Van, it looked like it was being force fed! (...)

A. wanted to come down via the NW couloir, I said no, that this is often the side where slabs form, but since others had gone that way and it looked like the skiing was good, I ended up giving in.

We started our descent. It was excellent, although the couloir was already pretty churned up (about a dozen tracks before us)!

A. and L. were lower than me, sheltered on the left side of the couloir. I allowed myself to be carried away by the elation of the descent and left the couloir to ski on an untouched slope on the right side. Lower down, I had to take a side slope to get back to the couloir. I am always a little apprehensive
of avalanches, but there were a fair few blocks of rock visible and I told myself they act as anchor points, preventing the slab from sliding. Suddenly, a crack started, about 1m above me, spreading towards me: I was caught.

I couldn’t react and surrendered to the avalanche; the pressure forces were quite incredible. My head went under the snow and I swallowed a little before coming back to the surface. I felt squashed in all directions as the avalanche channelled into the gully. Suddenly everything stopped and I was only waist-deep. I hadn’t lost my skis. (...)

**Aggravating factors**

The fact that the couloir already had tracks made me want to seek out untouched snow fields that were potentially less stable than the couloir axis.

My avalanche transceiver put pressure on one of my ribs due to the compression forces of the snow. (...) But I’m not blaming the device, and am not questioning its utility.

**Consequences on subsequent practice of the activity**

This was a good warning against behaving like an idiot. I knew full well that it was risky, but I let myself be persuaded twice to go where I didn’t originally want to go. I ended up forgetting all the rules of caution because it was just so good to be flying through snow, with powder up to my ears, leaving my tracks on the untouched snow. I had also over-estimated the anchorage of the snow mantle, something I’m a lot more careful about now.

The thing that really surprised me afterwards was that I just didn’t react while I was actually caught in the avalanche, I really was taken by surprise (since then, I have reacted very rapidly in similar situations).
This type of modelling remains highly dependent on the reports submitted. It is therefore important to be careful not to over-generalise. However, by multiplying the number of reports, their subjectivity and particularities are quashed, trending towards more general models that include a maximum number of examples, thus helping to improve our knowledge of the accident processes and prevention and protection barriers. As well as the number of reports, the level of detail of the descriptions is another decisive factor. On average, the reports in SERAC mention 2.2 contributing factors. It is encouraging to have overcome the single-cause vision of the event, which focusses on just one cause (e.g.: “the avalanche was due solely to an over-load”, ignoring all other potential factors), but even more detail in the reports would enable a more thorough analysis.

A growing number of reports and the community’s increasing tendency to report their experiences are likely to result in more detailed reports. Whenever the SERAC database is presented, highlighting the consideration of multiple risk factors rather than a single cause will also be beneficial in the long run. Ultimately, this community tool is likely to help to develop a more thorough risk management culture.

It is encouraging to see that in 10% of reports, respondents mention increased distrust in situations where the conditions are similar to those of their previous accident or incident: a type of snow that they did not consider to be risky, an apparently safe situation, factors that they previously thought to be reassuring… Some say that they find it easier to turn back, and that they conduct their own assessment of the situation systematically, rather than relying on others.

In terms of training and prevention, the type of graphic presented previously offers a detailed view of what happens before and after the event. It makes it easier to identify the main accident-generating factors, how they interact and also how to prioritise the barriers to be implemented to counter them.

In order to create a model that overcomes the singularity of each case, a graphic illustration, fed with each new report and using storybuilder software \(^1\) is being developed. This software was initially to analyse occupational accidents, but is currently being adapted to the case of mountain sport accidents to create a model for each type of event (avalanche, fall of a person, rock or ice fall, etc.).

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As the SERAC database grows, the accumulated data will enable the development of increasingly realistic, coherent and convincing models. New models may be proposed if the reports reveal specific events that have not been identified so far by the project. Each of the reported events is entered in the corresponding model, representing the process (accident sequence) of the scenario. Graphs will be available for individual events or for all reported cases. The occurrence of recurrent risk factors will be quantifiable, allowing quantitative analysis to highlight sequences of contributing factors that result in problem situations or associations between such factors and user profiles. Ultimately, a graphic database will be produced, containing all the essential information of each incident or accident experience.

This video sequence gives an idea of the possibilities available here:
www.petzl-foundation.org / Understanding mountain sport accidents
Fondation Petzl

Our support for this project and the SERAC database reflects our ambition to develop knowledge in the field of mountain sport accidentology. We firmly believe that prevention actions and training courses can be improved thanks to a better understanding of accident circumstances and the risk factors involved.

Since 2006, the Petzl Foundation has been providing support to non-profit organisations for the benefit of the mountain and climbing communities. Our efforts are concentrated in three fields:

- Accident prevention;
- Conservation of ecosystems with difficult or vertical access;
- Gaining new knowledge of our vertical world.

Contact
Olivier Moret
Secretary General
Tel.: +33 (0)4 56 58 19 78
E-mail: omoret@fondation-petzl.org
www.petzl-foundation.org

Laboratory of Vulnerability and Innovation in Sport

The Laboratory of Vulnerability and Innovation in Sport (L-ViS) counts 25 research professors and around twenty post-graduate students working on sport issues in the fields of sociology, psychology, history and management. This range of disciplines contributes to the study of the risks induced by the practice of physical and sporting activities (accidentology, burn out or gender discriminations), as well as how sporting activities can be used to reduce certain vulnerabilities (including chronic illnesses, handicap and ageing). Sport is also a field of innovation in its various forms (equipment and technology, social, in terms of practice or as a service), which are studied by L-ViS, notably in terms of the ability of sport to “resolve” the vulnerability situations investigated.

Contact
Bastien Soulé
Scientific supervisor of the research project on accidentology of mountain sports
E-mail: bastien.soule@univ-lyon1.fr
l-vis.univ-lyon1.fr

Camptocamp.org serves as both “Wikipedia” and “Facebook” to the mountain community, providing free information on mountain trails and climbing route conditions.

Over 18 years, with nearly 400,000 visitors each month, this collaborative website - translated into seven languages - has become the largest platform for sharing information on the mountains in Europe. The Camptocamp association which manages camptocamp.org is staffed entirely by volunteers.

Contact
board@camptocamp.org
www.camptocamp.org

www.camptocamp.org