A STUDY OF AN AVALANCHE AT NISEKO, JAPAN

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ABSTRACT: On 28th January 1998 an avalanche accident occurred near the Japanese ski resort Niseko Alpen in Hokkaido. The snow properties of the crown surface was investigated. A weak layer composed of faceted crystals was found at a depth of 1m at the release point. Meteorological data at the observation site (1km distant) suggested that they developed on 19th January. We conclude that the passage of a low pressure front rapidly cooled the snow surface and the induced large temperature gradient near the surface caused development of the faceted crystals.

KEYWORDS: avalanche accidents, weak layer, faceted crystals

Introduction

At noon on 28th January 1998 a party of four walkers was hit by an avalanche near the Japanese ski resort Niseko Alpen in Hokkaido (Figure 1). The three victims were found alive after an hour at depths of 2-3 meters. One of the victims subsequently died of cardiac insufficiency in hospital.

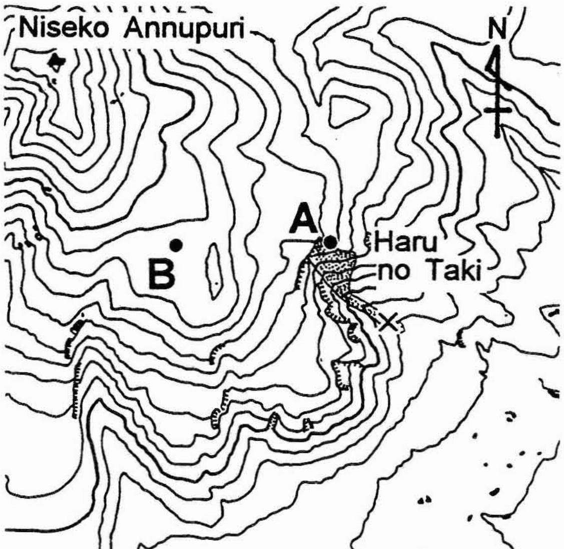

Figure 1. Location map of the observation site. x: the spot of the accident, **A**: releasing point, **B**: observation site.

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The avalanche started about one kilometer up the valley (400m vertical) when a 1m thick slab fractured on a 34 degree slope. The avalanche descended cliffs and then ran for 700m along the 7 degree valley floor and was roughly 30m wide where it hit the walkers.

The Niseko area is a well-known ski resort in Hokkaido, Japan. Haru no Taki (it means Spring Falls) is located between two ski areas, and is always closed to skiers due to the high avalanche danger. Many avalanche accidents have occurred here including one that involved 6 skiers on 15th January 1990 (Akitaya and others, 1990).

The morning after the avalanche we investigated the snow properties of the crown surface and the debris. In this paper, we would like to focus attention on the formation process of a weak layer, which was the fracture surface.

Observation at the release point

Figure 2 shows snow pit data at the crown surface (820m a.s.l.). There is a weak layer composed of faceted crystals at a depth of 1m. The thickness of the weak layer was 10-20mm, and the grain size was 0.5-2mm. The shear frame index of the weak layer from the shear frame tests was 3.1kPa, and the stability factor (McClung and Schaerer, 1993) was calculated to be 3.8. This value is not so small, but slab avalanches can start when the stability factor is

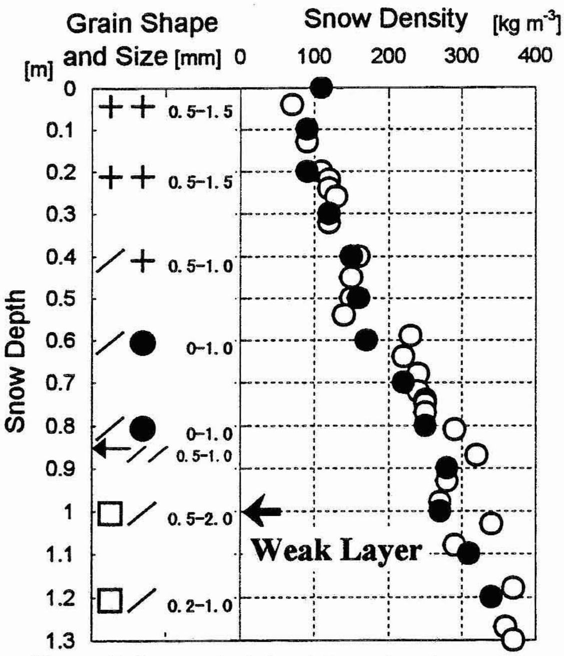

Figure 2. Snow pit data at the releasing point on 29th January 1998. ●: density profile at A, ○: density profile at B (27th January).

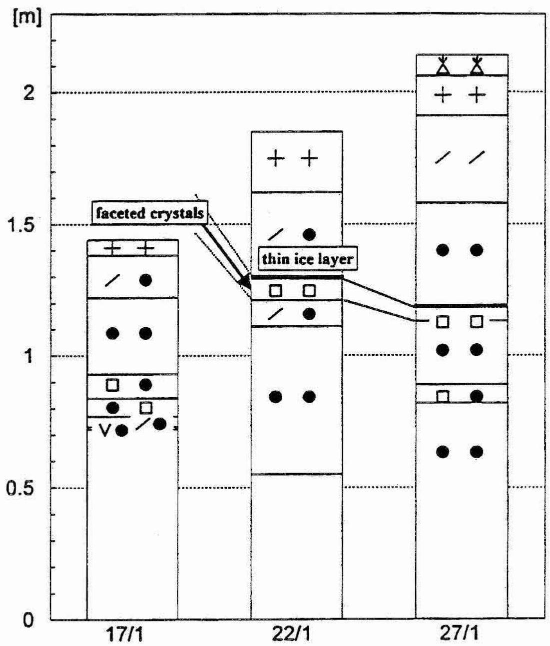

Figure 3. Snow pit data at the observation site.

as high as 4 (Roch, 1966). The deposited snow above the weak layer had no gaps from the surface to 0.6m depth, and the density was below 200 kg m^{-3}. This shows that the snow did not accumulate under strong windy conditions. Although partly decomposed particles at the depth of 0.84m were relatively weak, they did not become a sliding layer.

Snow pit observation

Over the 97/98 winter snow pit measurements were regularly carried out at a site about 1km distance from the releasing point (930m a.s.l., Figure 1). Results are shown for 17th, 22nd and 27th January in Figure 3. The same weak layer was observed, at a depth of 0.95-1.01m On 27th January, at this site (see Figure 2). This layer was observed on 22nd January, but not observed on 17th January. Thus, the weak layer formed between 17th and 22nd January.

Meteorological observation

Meteorological observation was also performed at the site. Air and snow surface temperatures, wind speed, solar radiation, snow depth and snow count (that is intensity of snowfall) were all measured. Results from 17th to 28th January are shown in Figure 4. The air and the snow surface temperature increased to 0 °C on 18th January and decreased rapidly the next day due to the passage of a low pressure front. A thin ice layer above the layer of facets in Figure 3 corresponds to this event: the snow surface melted slightly and then refrozed. Thus we conclude that the weak layer formed as follows: rapid cooling of the snow surface on 19th January induced large temperature gradient near the surface and the faceted crystals developed.

After the formation of the weak layer, 0.95m of new snow fell (water equivalent 0.17m), and then the avalanche occurred. The wind speed was under 7m s^{-1} for the whole period under consideration.

Concluding remarks

Most people believe that avalanches in the Niseko area only occur after storms with strong winds. However, this avalanche clearly shows how a dangerous situation can arise even in low wind conditions.

Fukuzawa and Akitaya (1993) reported that depth hoar crystals developed largely under the combination of internal melting / warming beneath the snow surface and radiation cooling during nighttime. In this paper we would like to emphasize that a weak layer composed of faceted crystals formed under the large temperature gradient due to the passage of a low pressure front.

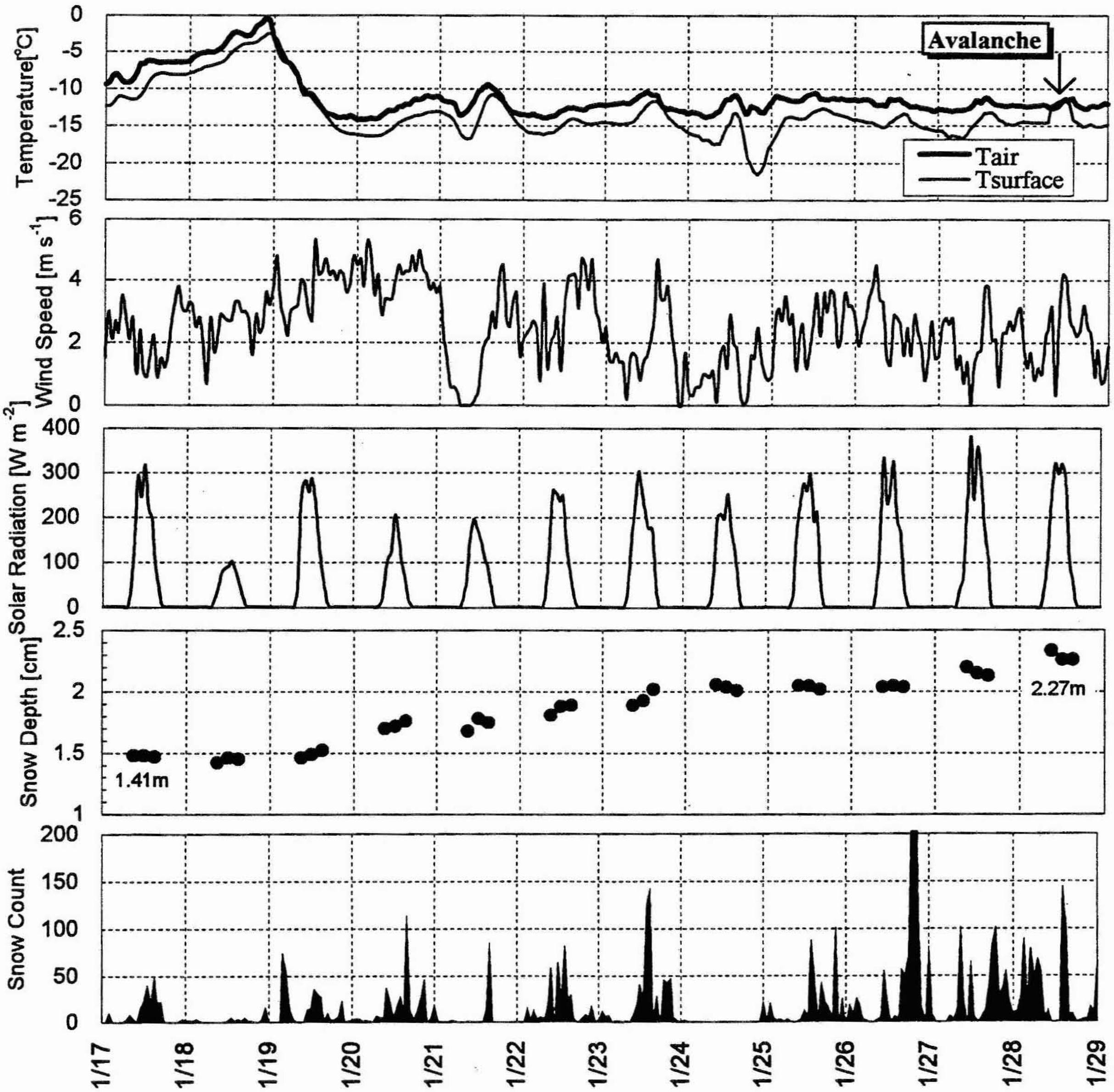

Figure 4. Meteorological data at the observation site.

A further paper is in preparation on the dynamics of this avalanche.

Acknowledgments

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