REMINDER: TOMORROW

Geological Survey of Canada - Quaternary Discussion Group
Commission Géologique du Canada - Groupe de Discussion sur le Quaternaire

The 1991 Randa rockslides (Valais, Switzerland): Past, present and future

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presented by/ presenté par

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Abstract / Resumé

About 30 million cubic meters of rocks fell from a rock face near the village of Randa (10 km north of Zermatt) in two main stages: the first one on April 18, 1991, and the second one on Mai 9, 1991. No fatalities were reported except a few horses, cows and sheep. 31 chalets were buried. Both events caused the deposit of 10 to 40 cm of dust in a radius of approximately 1 km from the rockslide area.

The April 18th event interrupted the railway line connecting Zermatt to the Rhône Valley. The Mai 9th event was forecasted using detailed field, seismic and geodetic surveys; the area was evacuated. The railway line was buried for 800 m and the road for 200 m. The fallen rock mass dammed the Vispa river. About 30 houses were flooded, due to heavy rainfalls and snowmelt. The Swiss army succeeded in digging a channel before a potential catastrophic failure of the dam, which will have destroyed all the downstream villages.

The rockslide is located in a busy alpine valley, especially frequented by tourists visiting Zermatt and the Matterhorn (Cervin). The total economical impact is difficult to estimate, but the cost of works and surveys exceeded $CAD 110'000'000.

Both 1991 rockslide events are the results of particular slope conditions and structures. The structural settings were particularly unfavorable: a moderately steep continuous fracture cut the base of the rock face and three persistent joint sets divided it into large blocks, preventing a rock-avalanche-type deposit. Those joints promoted the development of two ancient landslides above the rock face. These pre-existing instabilities had as results on one hand to provoke an excess load on the top of the rock face, and on the other hand to increase the permeability of the substratum and therefore the infiltration rate. This promoted groundwater circulations that favored rock weathering and water overpressure. Those processes led to rock fatigue and to the creation of big blocks that suffered small movements, breaking progressively the remaining rock bridges.

Observations of precursory small rockfalls during the 10 years before the 1991 events illustrate the progressive mobilization of the rock blocks. The 1991 rockslides finally occurred during a snow-melt period. Jets of water near the basal slip plane were observed just before and during the 1991 events, indicating that water overpressure acted as releasing process.

At the present time, the upper part of the scar is still slowly moving towards the Southeast at a maximum speed of 1.5 cm/year. The movements are monitored by monthly geodetic and extensometric survey. A database was specially designed to facilitate the monitoring. This database will also be used for the monitoring of other instabilities. This present day instability forced the authorities to move the road and the railway line, to prevent them to be hit by the potential new rockslide.