



Field trip 2

Protection of an hamlet from large volume rock falls: blasting and protection structures – La ripaillère

Context

The Néron (1298 asl) is a well-known submit in the Grenoble Conurbation which belongs to the Chartreuse calcareous massif and exhibits a rather linear and sharp crest. In 2003, dwellings in the valley were dramatically threatened by rock falls after a forest fire ravaged the forest on the steep western flank of the Néron. By contrast, the eastern flank of the Néron exhibits an abrupt and highly fractured cliff over a steep and forested slope which terminates on the Clémencières pass. In 2004, an inspection revealed that the hamlet located in this pass was threatened by unstable rock compartments with a total volume of 4500 m³ (typically 10 and 60m in width and height resp.) uphill the Ripaillère hamlet. The first collapse concerned 1500m³ of rock and occurred on 2011/08/14. Inhabitants were evacuated before this event based on the continuous measurement of the displacement of larger compartments. After a 800 m run-out, 18 blocks with size often exceeding 2 m were intercepted by a rockfall protection embankment. This embankment was built in 2007 at a distance less than 100 m from houses (265m in length, 7.5m in height, unreinforced structure with a rockery facing). Many blocks stopped in ditch and did no impact the embankment.

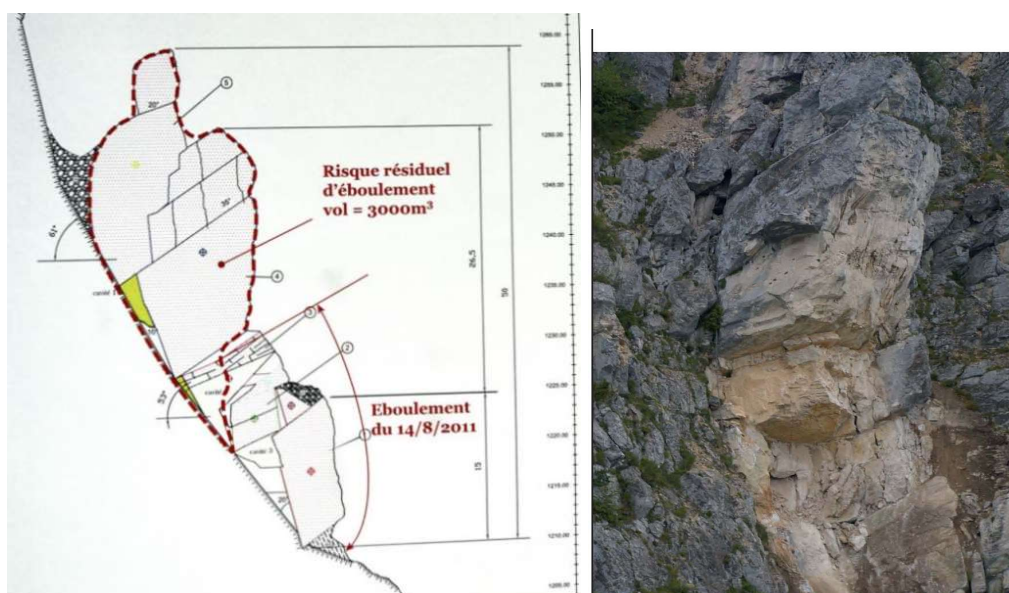


Figure 1. Cliff cross section showing the unstable rock mass (left). Front view of the cliff after the first collapse (right).
(Photos: Sage Ingénierie)



Decision was made to remove the remaining unstable rock mass, which amounted 3000m³, by blasting. In this perspective, the protection insured by the embankment was extended with a 60m long high capacity flexible barrier. This was motivated by results from specific rockfall trajectory simulations which suggested a larger lateral spreading in the direction of unprotected houses. About 400 kg of explosives were used to blast the compartments and reduce the size of the blocks at release. The blasting occurred on 13 December 2011. The embankment was reached by 7 blocks with a 3-10m³ volume. The very last block was intercepted by the flexible barrier. Most of the blasted volume was thus stopped on the slope. The kinetic energy of the blocks decreased due to the interaction with the slope vegetation (large diameter trees were cut) and to penetration in the ditch.



Figure 2. Rock block after interception by the embankment, after the natural event. Additional protection structure built in view of blasting (Photos: Sage Ingénierie)



Figure 3. Drilling operation in view of blasting (right). Large impact caused by a rock block in the ditch. (Photos: Sage Ingénierie + S. Lambert)



Forest fire on a rockfall prone area equipped with barriers: case of La Buisse and Voreppe

Context

A fire broke out on 08/05/2022 near the Maquisards belvedere south of La Buisse towards Voreppe. The fire continued to spread for several days, despite a significant deployment of firefighting means.



Figure 4 : Photographs of firefighting interventions (Source : SDIS 38)

The fire spread over a large part of the southern flank of Roche Brune above Chemin des Balmes in the west to the hillsides upstream from the hamlet of Malossane.

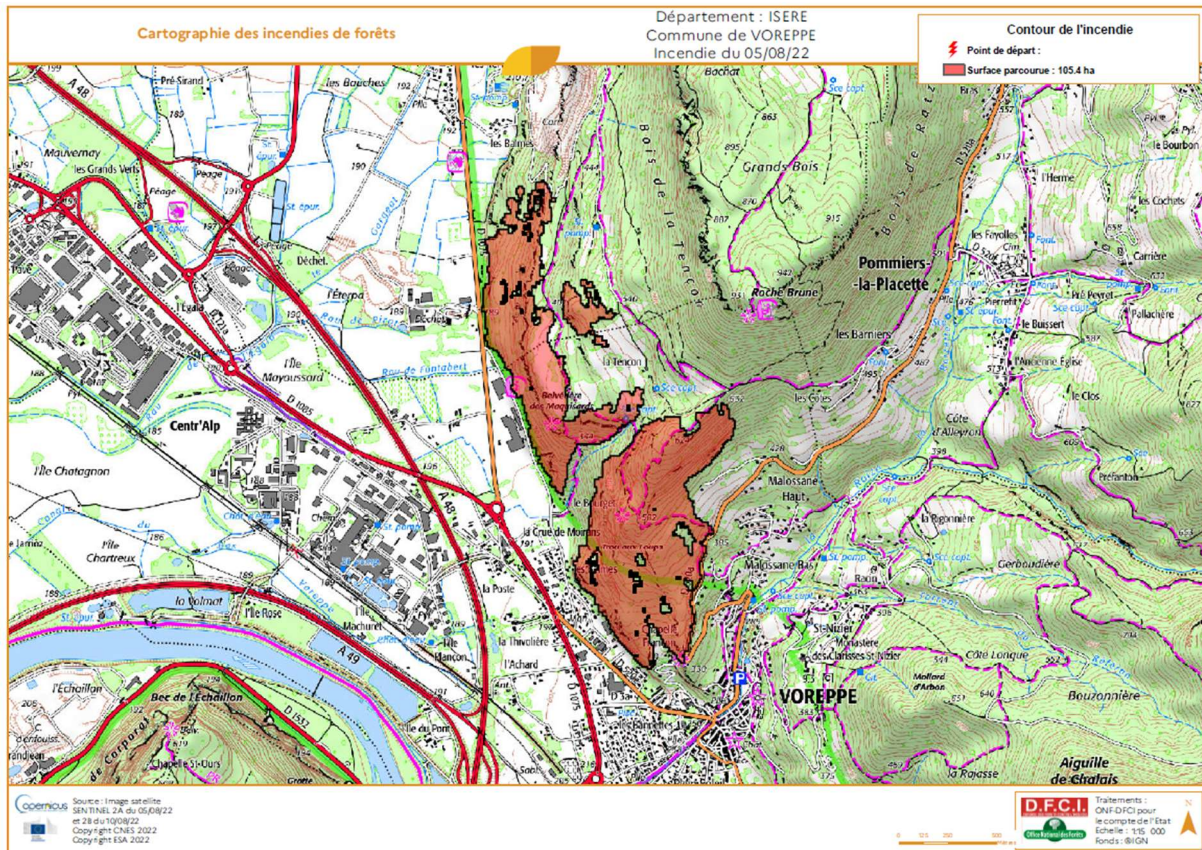


Figure 5. map of the burned areas

Observations

The areas crossed by the fire, let appear bare ground and bedrock, occasionally releasing small rock boulders. An increase in the frequency of small boulder falling was observed.

Many of the downstream dwellings were already in a high-risk area in the PPR (risk prevention plan) of the municipality of Voreppe. The rockfall barriers protecting these dwellings are difficult to access because they are located on the ledge above the first cliff upstream of the buildings. Even though these metal works were exposed to the fire, visual inspection didn't reveal any significant change in characteristics due by the flames. These works were considered to still constitute effective parades against the fall of small-sized rock blocks. After the event, the frequency of falls of blocks of a few liters increased; this increase was observed through the stones stopped in the nets and some small walls. No change was noted concerning large volumes.

Questions are :

- should the PPR hazard map be modified and take into account any larger mass departures?
- should we review these mitigation structures?



Figure 6 : exposed limestone slopes upstream of Malossane-le-Haut.



Figure 7 : limestone cliff above Impasse Lavoisier. (fire propagates in its upper part)



Figure 8 : View of the Balmes structures; northern section (flexible barriers) upstream of the built-up areas. In the background, the hamlet of Le Bourget, which was not affected by the fire. (Source: SDIS 38 – 9 August 2022)

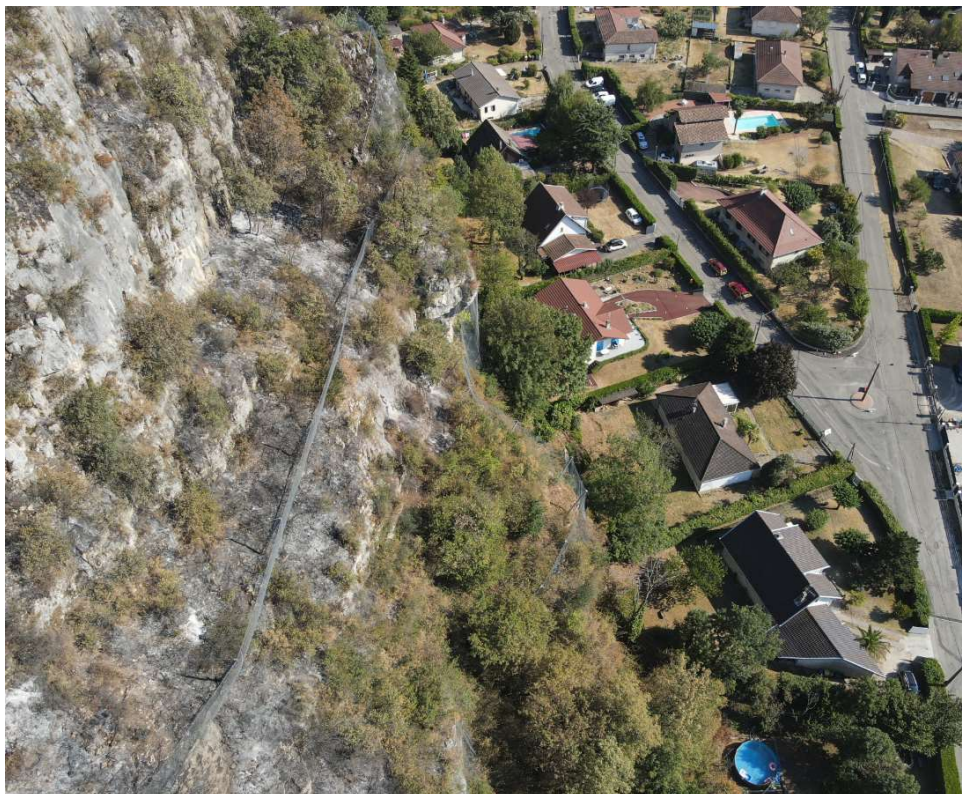


Figure 9 : Condition of the Balmes structures; central section (metal mesh) upstream of the built-up areas. The structures and vegetation in the lower part of the ledges are in good condition. (source: SDIS 38 – 09/08/2022)

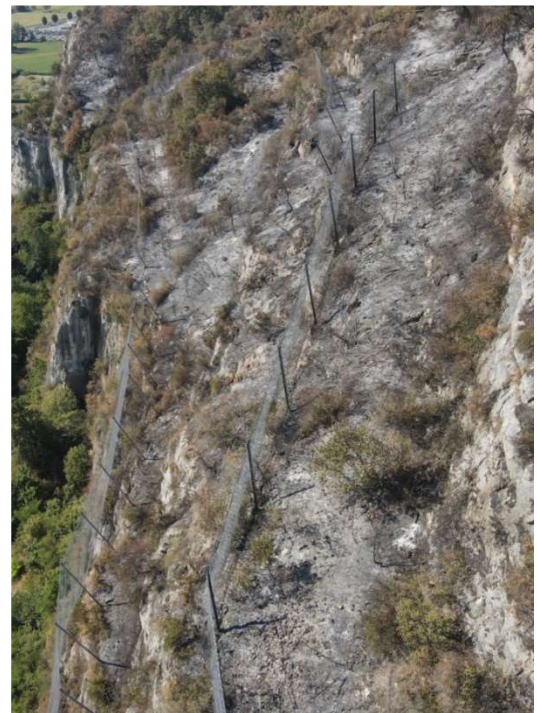


Figure 10 – View of the structures at Les Balmes; southern section (metal netting) upstream of the built-up areas. (Source: SDIS 38 – 9 August 2022)