Geophysical reconnaissance of an ancient landslide in the region of Malmedy – visualised by a 3D geomodel

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1. Introduction

In the frame of the relaunched geological mapping project of the Walloon region, formerly unknown geomorphological structures have been discovered on the southern slopes of the Warche valley in Bévercé (region of Malmedy): a steep scarp, of 20 m height and ~ 100 m length, next to two landslides (Mreyen et al., accepted). These features developed in a Permian conglomerate formation, the *Poudingue de Malmedy*, that occupies the Malmedy Graben and lies discordant on top of Cambro-Ordovician bedrock. Roughly perpendicular to the graben axis, the scarp has a N330°E orientation similar to that of the seismotectonically active Hockai Fault Zone (HFZ) that crosses the region (Demoulin, 2006). Here, we present a detailed geophysical field survey of the bigger landslide that lies directly adjacent to the scarp. Results are integrated in a 3D model of the slope and serve as input information to remodel its subsurface in terms of structural and/or geological interfaces and volumes.

2. Methods

In order to vary exploration depth and resolution, but also to guarantee validation of results, several geophysical techniques were combined: (1) passive seismics, i.e. H/V method, recording the ambient noise of soil with a single seismic station in order to determine its resonance frequency that can be used to calculate the 1D thickness of soft soil overlying the bedrock (several tens of meters can be reached depending on the geophysical properties of subsoil); (2) active seismics, i.e. seismic refraction along a profile line (115 m, i.e. 24 geophones spaced by 5 m, reaching depths of ~ 30-40 m), analysed in terms of P-wave tomography (SRT) and 1D surface wave analysis (MASW); and (3) electrical measurements, i.e. electrical resistivity tomography (ERT), illustrating resistivity contrasts of the subsoil along a profile line (315 m, i.e. 64 electrodes spaced by 5 m, reaching depths of max. 50 m). H/V, in particular, is increasingly used in landslide studies as it can provide useful applications such as the detection of basal slip surfaces (e.g. Pazzi et al., 2016).

3. Results

Results of data interpretation were compiled in a 3D geological-geophysical model supported by high resolution remote sensing data of the ground surface (i.e. 1 m resolution LiDAR-data provided by the Walloon region). By the interpolation of such information, we are able to characterise the soil of the study area in depth.

Fig. 1 represents the surface- (with projected orthophoto) and geomodel of the bigger Bévercé landslide, together with interpolated surfaces based on H/V measurements (detected interfaces in the subsoil deduced by measured impedance contrasts) and seismic as well as electric tomographies

(due to significant contrasts in velocity or resistivity, respectively). Also, on the scarp and in its prolongation, a supposedly tectonic shift of bedrock could be imaged and was integrated as fault plane in the geomodel. On the basis of the constructed surfaces, volumes representing stratigraphic or geological units were computed. We could thereby differentiate between in-situ rock, i.e. conglomerate lying on top of the bedrock, and the supposed mass of landslide (i.e. failed mass) that is marked by reduced seismic velocities (in terms of both, P-wave and S-wave velocity).

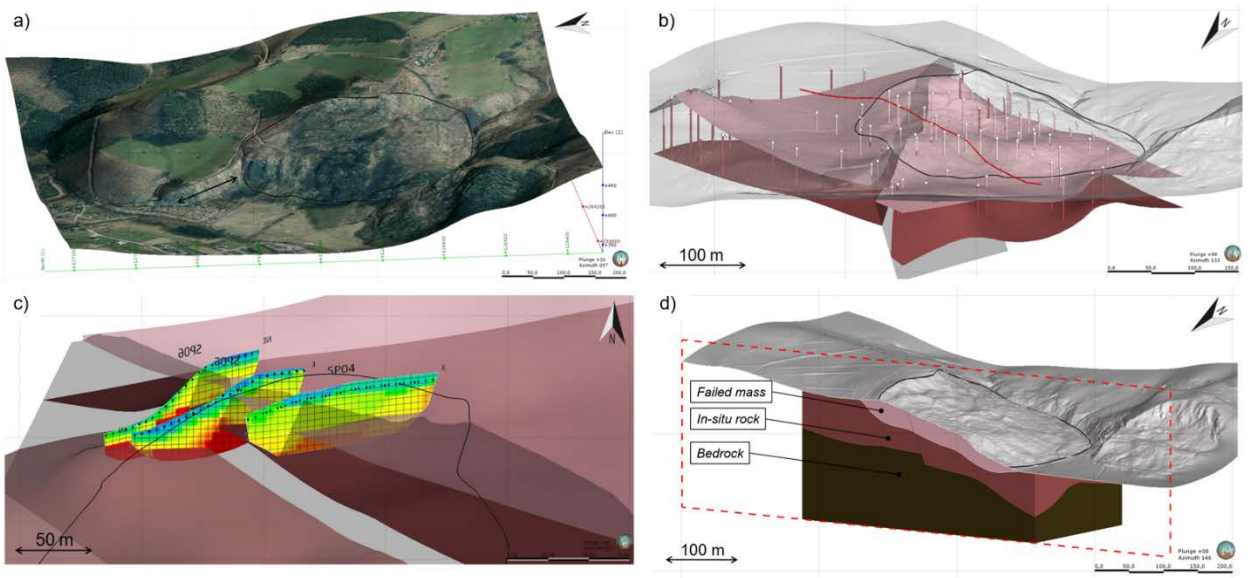

Figure 1. Geomodel of the Bévercé slope: a) surface model with projected orthophoto; b) interpolated surfaces on the basis of H/V measurements; c) modelled fault plane in line with seismic velocity contrasts; d) section of modelled volumes along red line shown in b.

4. Acknowledgements

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5. References

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