



Geophysical investigation of landslides and fault scarps in the Hockai Fault Zone, Belgium

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During several years, a series of geophysical surveys have been carried out in East Belgium to study the seismically active Hockai Fault Zone (HFZ). The most prominent earthquake that occurred in that fault zone is the 1692 Verviers Earthquake with a magnitude of M6-6.5; it is also the largest historical seismic event in NW Europe. The geomorphic impact of the fault zone is expressed by several landslides, NW-SE orientated scarps and paleo-valleys generated by river diversions. The NW part of the HFZ (near Battice, Belgium) is also known as the Graben de la Minerie; here, geophysical measurements confirmed the presence of a series of fault scarps and helped imaging the general basin structure related to vertical offsets of coal seams that had been found during former mining works. In the southern part of the HFZ, the ENE-SWS orientated Paleo-Warche-Valley (that was formed before upstream capturing of the Warche River) crosses the fault zone over a distance of 5 km. The shallow subsurface of this area was further investigated by geophysics to identify fault structures.

The work presented here is focused on the SE prolongation of the HFZ (region of Malmedy, Belgium). Two new clear morphological markers unknown before were detected through analysis of a LiDAR-DEM recently published by the Walloon Region. The following geological-geomorphic survey confirmed the presence of a NNW-SSE oriented, 100 m long and 20 m high, scarp and an associated landslide (about 8 ha) with minimum age of 300 years. The landslide was formed in the Poudingue de Malmedy, a local Permian conglomerate lying on top of a quartz-phyllite bedrock. Different geophysical methods were applied to investigate the subsurface: microseismic measurements (H/V method), seismic refraction tomography (combined with surface wave analysis) and electrical resistivity tomography. To establish the structural relationship between the fault scarp and the landslide and to estimate the offset of the Poudingue de Malmedy, the geophysical results were represented in a 3D geological model. In order to back-analyse the formation of the landslide (also possibly related to an earthquake associated with the fault zone), a pre-failure model is proposed on the basis of several cross-sections studied through 2D dynamic numerical modelling.