Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04034, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04034
EGU General Assembly 2008

Influence of the geological structure on the geometry and dynamics of two large landslides within glaciolacustrine clays (Trièves area, french Alps)

G. Bièvre (1,2), U. Kniess (1), D. Jongmans (1), S. Schwartz (1) and V. Zumbo (2)

(1) LGIT, Université Joseph Fourier, BP 53, 38041 Grenoble Cedex 9, France (2) CETE de Lyon, Laboratoire régional d'Autun, BP 141, 71404 Autun cedex, France
(gregory.bievre@ujf-grenoble.fr)

The Trièves area is a large depression (800 m asl) located within the French alpine foreland 40 km south of the town of Grenoble. It coincides with the position of a 300 km^2 palaeolake created by the damming of the Drac River by the Isère glacier during the last maximum glacial extension (Würm period, 45 000 yr BP). The lake was progressively filled by varved clays resulting from the erosion of the surrounding crystalline and limestone massifs. These clayey formations which can reach 250 m thick overlay an irregular paleo-topography made of compact alluvial layers and mesozoic marly limestones. After the glacier retreat (10,000 to 15,000 years BP) the rivers cut deeply into the geological formations, triggering landslides in the clay deposits over at least 15% of the Trièves area. Some of these slides might affect surfaces as large as 500,000 m^2 with the deepest slip surface estimated or measured at about 40 m depth. To the north of the Trièves area, the left bank of the NS oriented artificial Monteynard lake is affected by several large imbricated landslides. Our study is focused on two of these landslides. The translational Avignonet slide affects a surface of about 1.10^6 m^2 with a global eastward downslope motion towards the lake. The slide velocity at the surface increases from 0 to 2 cm/yr at the top to more than 14 cm/yr at the toe. Just south of this slow moving slide, a quick mudslide (L'Harmalière) occurred in March 1981, creating a head scarp of 30 m high and affecting a surface of about 450,000 m^2 in the same material. Between 1981 and 2004, the head scarp has continuously regressed with an average of 10 cm/year in a north-eastward direction and

now intersects the southern limit of the Avignonet landslide. The global direction of the landslide motion is SE, making an angle of about 45° with the topography slope.

These two adjacent landslides, which exhibit very different geometrical and dynamical characterisitics, occur on identical slopes made of the same material. In order to understand these differences, we combined morphological, geological and geophysical investigations. First, we built a high resolution Digital Elevation Model (DEM) using an airborne Lidar (Light Detection And Ranging) acquisition. The DEM points out the boundaries and the internal geometry of the slides. The Avignonet landslide exhibit a crescent shape with a longitudinal convex profile at the toe. On the contrary, the L'Harmalière slide is more elongated with a funnel shaped track zone through which the material flows to the lake with a concave regular slope. Geological mapping below the Avignonet landslide showed that the bedrock outcrops along the lake and constitutes a butress which prevents deep slip surfaces to daylight on the slope. On the contrary, the L'Harmallière landslide developped at a site where alluvial layers outcrop along the lake, corresponding to a former NW-SE oriented talweg of the Drac. Micro-tremor measurements using the single station technique were performed over the two landslides. Computing the horizontal to vertical spectral ratio of the noise records allows the resonance frequency to be determined. The results over the Avignonet landslide show a strong westward resonance frequency decrease (from 0.6 Hz to 5 Hz) which indicates the thinning of the clay layer (from about 200 m to 20 m) linked to the rising bedrock.

All the acquired data suggest that the paleo-topography of the bedrock is the main parameter controlling the geometry and the dynamics of the two studied landslides. The Avignonet landslide moves slowly perpendicular to a NS oriented bedrock ridge, while the L'Harmallière mudslide developed over a former talweg which removed the bedrock buttress and has allowed and still allows the slide and flow of a large volume of clayey material into the lake.