Geophysical Research Abstracts
Vol. 12, EGU2010-12161, 2010
EGU General Assembly 2010


# Main flow path and chemical alteration in a marly hill prone to slope instability: assessment from petrophysical measurements and borehole image analysis.

Johanna LOFI (1), Stéphanie GAUTIER (1), Philippe PEZARD (1), Didier LOGGIA (1), and Emilie GAREL (2)
(1) Géosciences Montpellier, University of Montpellier 2, France (johanna.lofi@gm.univ-montp2.fr), (2) Université d'Avignon et des Pays de Vaucluse, France

The principal driving force of slope movements is generally considered to be gravity, with the main triggering factor being the increase of pore pressures by the presence of water contained in the geological environment. It is however difficult to anticipate the rupture processes involved in deep seated landslides mainly because of the difficulty in estimating the mechanical behaviors at the scale of the hill slope which is characterized by heterogeneous structures with large and small scale discontinuities. Hydrogeological behaviors are also important parameters and the localization of the main flow paths and saturated zones is a fundamental stage of the slope evolution before and after failure. The processes involved in the rupture is also rock type dependant. Clay shales that have complicated structure at a small scale and are sensible to weathering are very prone to slope instability.

In this context, this study focuses a non slided slope made of tectonised clay shales in the Draix Observatory (ORE DRAIX) of the southern Alps (France). The objectives were to characterise at several scales (several m - $\mu$m) the internal architecture and main structural and lithological discontinuities of the hill slope in order to locate preferential water flows within the system, and anticipate its possible evolution. This work is based on a mutli-disciplinary approach including petrophysical analyses in the laboratory, well pulse injection tests and downhole geophysical measurements. Optical and acoustical images have been used as an original and efficient tool for internal discontinuities characterization at several scales (several mm – several m) and potential active flow path detection. In all, the integration of measurements leads to propose a simple scenario of fluid circulation and chemical alteration of the hill slope.

Owing to the very low permeability of the non altered black marl matrix, the open fractures evidenced from borehole images may be the primary pathways for rapid water circulation from the surface down to depth. Because these fractures are not ordered randomly at the scale of the hill, we suggest that main flow paths mainly occur within a sedimentological unit located at an intermediate depth and containing abundant open fractures. This unit possibly reflects an intermediate stage of chemical shale alteration, sandwiched between a weakly altered unit below, and a highly altered unit possibly partly allochtonous, above. Our observations also suggest that massif alteration is asymmetrical, possibly as a result of weathering, water circulation and anisotropic internal structure of the shales. Flow paths are expected to follow the structural and sedimentological discontinuities with a global south-east direction.

The methodological approach developed in this study may help evaluating future slope instability. From a mechanical point of view, the anisotropic structure of the shales is evident, favouring rupture along the shistosity and fracture planes. It is probable that chemical alteration due to water circulation along the observed discontinuities may create weakness zones or planes possibly evolving in slope rupture when combined with other factors. If a deep rupture occurs in the hill, the intermediate unit and/or its contact with the unit above should be considered as preferential zones for landslide initiation, with a mass displacement toward the south-east.

Acknowledgements: This work has been performed in the framework of the project ANR ECOU-PREF, supported by the French National Agency of Research.