Geophysical Research Abstracts
Vol. 14, EGU2012-327, 2012
EGU General Assembly 2012

A multidisciplinary geophysical, geotechnical and hydrogeological investigation of quick-clay landslides in Sweden

A. Malehmir (1), C. Krawczyk (2), U. Polom (2), E. Lundberg (1), A. Adamczyk (3), M. Malinowski (3), M. Bastani (4), M. Gurk (5), C. Juhlin (1), L. Persson (4), and N. Ismail (6)

(1) Uppsala University, Dept. of Earth Sciences, Uppsala, Sweden (alireza.malehmir@geo.uu.se; emil.lundberg@geo.uu.se; christopher.juhlin@geo.uu.se), (2) Leibniz Institute for Applied Geophysics, Hannover, Germany (charlotte.krawczyk@liag-hannover.de; ulrich.polom@liag-hannover.de), (3) Institute of Geophysics, Polish Academy of Sciences, Warsaw, Poland (michalm@igf.edu.pl; adamczyk@igf.edu.pl), (4) Geological Survey of Sweden, Uppsala, Sweden (mehrdad.bastani@sgu.se; lena.persson@sgu.se), (5) University of Cologne, Institute of Geophysics and Meteorology, Cologne, Germany (gurk@geo.Uni-Koeln.DE), (6) Syiah Kuala University, Banda Aceh, Indonesia (nazli.ismail@unsyiah.ac.id)

In Spring 2011, the Society of Exploration Geophysicists (SEG) through its Geoscientists Without Borders (GWB) program sponsored our project to study clay-related landslides in the Nordic countries. This project will study quick clay or rapid earth flow landslides in Sweden. Undisturbed quick clay resembles a water-saturated gel. When a mass of quick clay undergoes sufficient stress, it instantly turns into a flowing ooze, a process known as liquefaction. A small block of quick clay can liquefy from a stress change due to as little as a modest blow from a human hand, while a larger deposit is mainly vulnerable to greater stress changes, such as increased saturation by excess rainwater. Despite their abundance, our geophysical understanding of clay behavior in terms of both changes in the geometrical shape (clay formations) and changes in the physical properties are limited and require a better understanding. Quick clay landslides are not particularly constrained to steep slopes and have been known to slide even in low-to-moderate angle slopes.

Geophysical investigations began in September 2011 over a known landslide scar near the Göta river in southwest Sweden, an area known to contain quick clays in parts of it. The investigations involved 2D and 3D P- and S-wave source and receiver surveys, geoelectrics, controlled-source and radio-magnetotellurics, ground gravity and magnetic surveys. These data in combination with existing geotechnical information and hydrogeological investigations should allow better insight into the mechanism(s) governing clay-related landslides in the Nordic countries and to provide high-resolution images of subsurface structures down to the bedrock.

We will present preliminary results from the seismic investigations, including the 2D and 3D reflection and refraction surveys. The reflection seismic data show excellent quality and image the bedrock topography and internal layering above it down to about 100 m. Tomography results suggest the presence of low-velocity zones associated with some of the reflections, making the integration of the two methods interesting. A shear-wave survey also shows excellent data quality and very high resolution. It helps to image fine structures above the bedrock, as well as the bedrock topography. The level of the detail already revealed by the seismic data demonstrates that the project will be able to image fine structures associated with quick-clay landslides that are important and valuable for any site assessment.