Geophysical Research Abstracts
Vol. 13, EGU2011-1067, 2011
EGU General Assembly 2011

Geomorphological characterization and monitoring of slope movements between Salurn and Neumarkt (Adige Valley, Italy)

Chiara Boccali (1), Stefano Devoto (2), Claudia Strada (3), and Luca Zini (1)

(1) Department of Geoscience, University of Trieste, Italy, (2) Department of Earth Sciences, University of Modena and Reggio Emilia, Italy, (3) Autonomous Province of Bolzano, Italy

A sufficient knowledge on the kinematics and development of landslides helps to adopt proper measures that can be used to protect slopes and the environment in general (Ayalew et al., 2005).

For this purpose a broad spectrum approach to the study of landslides is indicated for the most complete understanding of the investigated areas.

In collaboration with the Autonomous Province of Bolzano a detailed geomorphological survey was started to identify and describe the slope instabilities of a mountainside along the Adige river, that was indicated by the authorities because it wasn't already study in detail and because of the presence, directly under the slope of elements at risk (villages, roads, ecc.).

The study area is located in the Autonomous Province of Bolzano and extends 35 km^2, fully on the left bank of the Adige river, from the border province of Bolzano - Trento until the beginning of the town of Neumarkt (BZ) in the North. The area is crossed by the line of Truden, thrust of late Hercynian age that bring the Ora Formation (*Gruppo Vulcanico Atesino*) above the Permian-Jurassic sedimentary sequence.

The study zone is dominated by two massifs (Monte Madrutta and Monte Prato del Re), which have characteristics comparable to those of Dolomite massifs: high vertical walls and debris cones as connection with the valley.

The glacial modeling has primary importance in the geomorphological conformation of the Adige Valley, that was completely covered by a glacier during the Würm glaciation. Close is the connection between the landslides and the past presence of the glacier itself, due to the huge ice mass could be expect a significant lateral pressure on the slopes. At the time of ice melting these slopes have been subjected to a decompression and then to a gravitational release of rock, fractured due the thrust of the ice.

The whole slope is affected by different types of landslide: on large-scale are observed lateral spreads, that interest great volumes of rocks, and on small-scale can be seen topplings, slidings and above all rock falls. For this reason and for a better comprehension of the specific kinematics the whole area was divided in 6 smaller zones, investigated in detail.

First of all was carried out a field investigation: geomorphological and geological information, taken directly on the field, are the starting point for defining the movements in place. Together with this were implemented literature searches, analysis of aerial photographs and digital terrain models. Having obtained a general framework was created geological sections, to have a three-dimensional view of the studied slopes.

These studies pointed out two different behaviors of the mountainside, directly correlated with the different lithologies and geological settings:

- Toppling and wedge-sliding dominate along the slopes overlooking the Adige Valley, causing the insulation of rocky pillars (very high and narrow in width), with these movements is associated a typical sliding of the Contrin Dolomite over the marly layers of Giovo Formation. These landslides are the most visible manifestation of post-glacial relaxation.
- Lateral spreads interest the two massifs of the area: great volumes of Dolomite, with assumed thickness of around 300-400 meters, slide above the ductile layers of the Raibl Formation, helped by the disposition of the rocky layers. Regarding the Monte Madrutta the motion is perpendicular to the observed fractures (evident as trenches), with a vector oriented E-W. The trenches are almost certainly inherited from the Jurassic tectonic, as can be demonstrated by the alignment of these phenomena with the major structural axis of the area (Line of Truden); the movement's freedom is given by the absence in the West of a large portion of Dolomia

Principale, caused by a complex post-glacial landslide towards the Adige Valley. Moreover the lateral spread is favored by the disposition as slight anticline of the rocky layers. For the Monte Prato del Re we assume a similar condition, given also the same lithology, and a movement towards SW, favoured by the orientation of the rock formations and assisted and/or dragged by the just described motion of the Monte Madrutta.

The described instabilities were identified by geomorphological and geological evidences: trenches of various sizes, cliff ledges, highly fractured rock, intersections between the discontinuity sets, presence of ductile layers under hard rocks.

In autumn 2009 a monitoring campaign was conducted in collaboration with the Autonomous Province of Bolzano.

In the first stage of monitoring only fixed points were installed. This technique provides the installation, inside the trench, of two metal screws, driven in hand, into the outcropping rock. These two screws will be the reference points for the measurements of the trench's width, which are carried out with a tape.

Secondly, the monitorings have become more specific and the technologies more advanced because of the particular interest of the Autonomous Province of Bolzano on a big wall located further to the south, which presented the greatest danger to the infrastructure. For this reason 5 electric rock crack monitoring devices have been installed: 1 to monitor a layer of rock in possible roll-over, 3 on a huge rock pillar in lateral spread and the remainder on a rocky wedge in potential sliding.

The measured values show a general stability with respect to fixed points, except for one case in which over 6 months there was a movement of 10 mm.

The actual results of the monitoring campaign with rock crack devices show, instead, a general extensive situation: almost all the monitored fractures have widened during this year (Autumn 2009 – Autumn 2010), with movements often directly proportional to temperature ranges. This instability has led the authorities to decide to remove one of the most dangerous rocky volume, that overhung the national road.

The future development of this work involves the installation of GPS benchmarks for a detailed monitoring of the movements taking place on the Monte Madrutta and on the Monte Prato del Re.

Measurements of landslide movements that integrate hydrological and geological data have greatly improved the knowledge of landslide mechanics and the integration of different techniques allows for a better understanding of this kind of phenomena and thus better protecting human settlements and infrastructures (Mora et al., 2003).

References:

Ayalew L., Yamagishi H., Marui H., Kanno T. (2005), "Landslides in Sado Island of Japan: Part I. Case studies, monitoring techniques and environmental considerations", Engineering Geology, 81, 419-431.

Mora P., Baldi P., Casula G., Fabris M., Ghirotti M., Mazzini E., Pesci A. (2003), "Global Positioning Systems and digital photogrammetry for the monitoring of mass movements: application to the Ca' di Malta landslide (northern Apennines, Italy), Engineering Geology, 68, 103-121.

Strada C., Cotza G. (2010), "Caduta massi sulla SS012 al km. 402+150, Salorno, Relazione geologica – geotecnica", Provincia Autonoma di Bolzano, 23 pp.