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Report and preliminary interpretations about the 22nd August 2006 anomalous rock fall along the Gran Sasso NE wall (central Apennines, Italy)

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On the 22th of August 2006, around 8.30 in the morning, a block of about 25*10^3 m^3 of calcareous rock detached from the NE wall of the Gran Sasso d'Italia massif (the highest peak of the Italian Apennines) at an altitude of about 2800 m a.s.l.. After the failure, the already jointed rock mass underwent a crumbling process and covered a difference in height of about 1500 m along the sub-vertical slope which characterize the highest part of the Gran Sasso massif. In this part the motion of the debris took place mainly by free fall and bouncing. In addition, after the detachment the landsliding mass divided into two parts: a first one fell down along a quite straight, ballistic trajectory, while another part was channeled within a chute following a more complicate path and involving other rock fragments along the path. In both cases the falling rocks reached the base of the steep slope where they spread over an area of about 35000 m^2; a part of the debris was then channeled within the highest portion of a deeply cut valley. In addition, immediately after the impact a huge dust cloud developed and rapidly moved covering a distance of about 3 km. Because of this dense and fast moving cloud the highway located few kilometers below the slope was closed about 1 hour long for security reasons.

As regards the geological controls on the slope failure, the shape and volume of the detached rock mass is clearly related to the presence of discontinuity sets that played a critical role as kinematic constraints. The jointing conditions within the rock mass are on their turn connected with the local structural setting, featured by tectonic lines of regional importance: one of the detachment surface clearly shows tectonic features such as slickenlines.

Since no seismic event was recorded as a possible triggering factor, the stress variations connected with the thermic conditions and with the permafrost melting which implies water circulation within the joints should be considered as possible causes that led to the rock failure.

Because of the objective difficulty to reach and directly observe the scar zone located on such a steep and high slope, the detached volume was only assessed by means of laser telemetry measurements from the nearest peak.

The most significant feature of the above described rock fall event is definitely represented by the high energy dissipation derived from the impact at the base of the slope and by the so generated dust cloud. As regards the impact energy, it has to be considered that the nearby seismometric devices of the Gran Sasso National Laboratory (LNGS), recorded the event: the seismographs are now being interpreted. Anyhow, similarly to the case study reported by Morrissey et alii (1999) and Wieczorek et alii (2000) in the Yosemite National Park, the energy of the free falling/bouncing rock blocks has been transferred not only to the ground but also to the atmosphere, thus creating an airblast effect and a consequent dense dust cloud. The latter has been driven by the airblast with high velocity and has been able to preserve an abrasive effect in a quite large area (about 110000 m^2) around and downslope the impact area. The abrasive effect is clearly testified by the uprooting and snapping of hundreds of trees in the above mentioned area. The causes of such an anomalous effect linked to the rock fall event can be found in the extremely high velocity of the falling rocks in its turn related to the steepness of the slope, which favored the free fall motion, and to the length of the path. Preliminary attempts to estimate the velocity of the debris at the base of the slope have been carried out and allowed us to estimate a velocity of about 80 m/s. The next steps of this research will consist of a more exact determination of the rock mass kinetic energy by means of both the definition of the impact magnitude inferable by the seismographs and the simulation of falling rock blocks.

Based on the overall geomorphic and geomechanical evidence of the whole slope, other portions of the rock mass with volumes ranging between 10^4 m^3 and 10^6 m^3, prone to the failure have been recognized. This evidence allowed us to hypothesize some possible scenarios that highlight considerable risk conditions for the highway and some little villages nearby, especially by taking into account possible canalization of both debris and dust cloud in case of large-sized events.

References

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