



Mass Movements triggered in Northern Pakistan by the October 2005 Earthquake

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On October 8th, 2005, an earthquake with Magnitude Richter M 7.6, the epicentre at 34.467°N / 73.577°E and focal depth at 26 km, caused besides the numerous casualties severe damage on landscape and infrastructure. A large number of aftershocks occurred along the Main Frontal Thrust Zone (MFT), striking NW-SE, the epicentres clustering on the north-western part of the continental convergent zone.

The cities of Muzaffarabad, Balakot and Bagh were affected to a large extent. Roads and bridges were destroyed or severely damaged. The largest Intensities were observed in the Khagan, Neelum and Jhelum valleys, where landslides, rockslides, rockfalls and debris flows were triggered, some of them temporarily damming rivers.

In the Jhelum Valley, South of Hattian, a large landslide was triggered, blocking the waterways of two small tributaries of the Jhelum River. The Hattian Slide originated on Dana Hill (2080 m asl., 34° 09'N / 73° 43'E), buried the small Dandbeh Village, it's dam creating a flooding hazard to parts of downstream Hattian Village.

The landslide was triggered on the thrust fault, striking NW-SE, separating the Kamlial Formation from the Murree Formation (Early Miocene). The latter is composed of red sand- silt and clay stone, forming the landslide mass. Dana Hill is completely shattered and crisscrossed by cracks, slumps and slides, cracks striking preferably NNW-SSE. The landslide run down almost 1000m height difference and 2,75 km distance within half a minute, run up on the other side of the valley and overrode a crest to reach the next valley.

The slide mass formed a large dam, situated at the confluence of the two small rivers creating a larger lake on the proximal valley and a small dam creating a small lake on the distant valley. The height of the dam reaches 250m to 350m. The proximal

and lower part of the dam is composed of sandstone fragments in a dominant matrix of disintegrated silt and clay stone; the distal part is formed mainly by large blocks. Satellite images before the event show an older sliding mass at the same location, which was overrun by the actual slide. This earlier slide could have been triggered by the 1955 earthquake.

Several outburst scenarios are possible:

- Failure of the dam by seepage / piping within the proximal part of the dam
- Backward erosion of the dam caused by overflow over the natural spillway
- Slump / slide of part of the eastern slope of Dana Hill in to the lake at high water level, causing a flood wave overtopping the dam

The landslide buried several dwellings; the reported death toll varies greatly. Several local farms have been evacuated in the mean time. A first assessment of the situation was carried out in November and further investigations are under way.