

# Preliminary investigation on catastrophic flow-like loess landslides induced by heavy rainfall in Northwest China

*Shuai ZHANG<sup>1,2</sup>, Ping SUN<sup>1,2</sup>, Ran LI<sup>1,2</sup>, Fawu WANG<sup>3,4,5</sup>*

<sup>1</sup>Institute of Geomechanics, Chinese Academy of Geological Sciences, Beijing 100081, China

<sup>2</sup>Observation and Research Station of Geological Disaster in Baoji, Shaanxi Province, Ministry of Natural Resources, Baoji 721001, China

<sup>3</sup>College of Civil Engineering, Tongji University, Shanghai 20092, China

<sup>4</sup>Key Laboratory of Geotechnical and Underground Engineering (Tongji University), Ministry of Education, Shanghai 200092, China

<sup>5</sup>Professor Emeritus, Shimane University, Japan.

**Abstract:** Catastrophic rainfall-induced loess landslide has long been a major concern in Northwest China, and this situation has been exacerbated recently due to the warming and humidity change along with the westward and northward movement of the 400 mm isohyet in China. In the past decade, rainfall-induced catastrophic landslides frequently occurred in Northwest China. In July 2013, three successions of rainstorms with daily precipitation higher than 100 mm struck Tianshui, Gansu, Northwest China and the ensuing thousands of shallow loess landslides resulted in 25 fatalities and the economic loss of 8.275 billion RMB. Generally, clustered rainfall-induced loess landslides are characterized by small scale, wide occurrence, unascertainable distribution, imperceptible pre-failure deformation, and frequent occurrence with severe destruction. However, large (even giant) loess landslides could be triggered in these events as well and the disintegrated loess can rapidly transform to flow-like loess landslides or even loess mud flows. Different from cascades of shallow loess landslides induced by heavy precipitation, large loess landslides induced heavy rainstorms are generally characterized by relatively deep sliding surface, large volume, and amplified disaster effect. Favorable infiltration channels such as tensile cracks and sinkholes are the prerequisite for large loess landslide occurrence as the infiltration depth of loess is limited. In addition, liquefaction sometimes appears during long and rapid motion in large loess landslides, rather than static liquefaction at the initiation stage in shallow loess landslides induced by rainfall.

**Keywords:** Flow-like loess landslide; Rainfall trigger Failure mechanism; Static liquefaction