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Preface to the Special Issue on Loess Landslides

WANG Lanmin[1,2], XU Chong[3], CAO Yanbo[4] and XU Yueren[5]

1) Key Laboratory of Loess Earthquake Engineering, China Earthquake Administration, Lanzhou 730000, China
2) Lanzhou Institute of Seismology, China Earthquake Administration, Lanzhou 730000, China
3) National Institute of Natural Hazards, Ministry of Emergency Management of China, Beijing 100085, China
4) College of Geological Engineering and Geological Engineering, Chang'an University, Xi'an 710054, China
5) Key Laboratory of Earthquake Prediction, Institute of Earthquake Forecasting, China Earthquake Administration, Beijing 100036, China

"Mountains that moved in the night; landslides that eddied like waterfalls, crevasses that swallowed houses and camel trains, and villages that were swept away under a rising sea of loose earth, were a few of the subsidiary occurrences that made the earthquake in Kansu (Gansu) one of the most appalling catastrophes in history." "The area of destruction, 100 by 300 miles in extent, contains ten large cities, besides numerous villages. It is the heart of the so-called loess country, where the soil is a mixture of clay and powered quartz. A narrower region was comprised in the landslides district, where the loose earth cascaded down the valleys and buried every object in its path." These are description fragments of loess landslides induced by the Haiyuan $M8\frac{1}{2}$ earthquake on December 16, 1920 by Upton Close and Elsie McCormick in the paper entitled "Where the mountains walked" published in The National Geographic Magazine (Close U. et al., 1922). This huge earthquake killed about 270 000 people. The above-mentioned loess country is called the Loess Plateau in geography. Because the epicenter is located in Haiyuan County which was affiliated to Gansu Province in 1920, the earthquake was also called Kansu earthquake in published English papers. Mr. Upton Close visited the macroepicenter area in February, 1921 under the auspices of the International Famine Relief Committee, and brought back one of the first accounts of the devastated area which is very valuable for later field investigations and research on earthquake-triggered loess landslides.

Loess is a kind of wind-laid soil with porous microstructure and weak cohesion, which formed in Quaternary. It is widely distributed in the Chinese Mainland covering 640 000 km^2 with thickness of tens meters to more than 200 m. The Loess Plateau in northwestern China is a continuous distribution of loess deposit with the most complicated topography, the biggest thickness and largest area in the world, involving in 7 provinces and more than 0. 2 billion people. It is also a seismically active region, where 8 great earthquakes of $M8$ and $M8\frac{1}{2}$, 22 earthquakes of magnitude 7. 0-7. 9 and 67 earthquakes of magnitude 6. 0-6. 9 have occurred, which killed more than 1. 4 million people due to both damage of houses and large-scale landslides in history. Among them, the Haiyuan *M*8½ earthquake in 1920 induced more than 5 000 loess landslides in the meizoseismal area of 20 000 km^2. Previous research showed that these landslides were mainly attributed to strong ground shaking, topography of slopes and high dynamic vulnerability of loess. With the rapid urbanization and large-scale construction of infrastructures, the Loess Plateau faces high earthquake hazard. This special issue on seismic loess landslides of *Earthquake Research of China* is to commemorate the Haiyuan *M*8½ earthquake's 100^{th} anniversary, which will warn people to recognize such a high risk of seismic landslides in the Loess Plateau and promote the study on prevention and mitigation of disasters of earthquake-triggered landslides. The following is an overview of contributions of this special issue.

Mapping the landslides of historical earthquakes is a basic work to characterize their spatial distribution. Zhang Weiheng et al. (2020) found that the landslides induced by the 1920 Haiyuan earthquake were mainly distributed in the intersection area between the end of the Haiyuan Fault and Liupanshan Fault, showing multiple dense distribution centers. They argued that the landslides around Tongwei County, Gansu Province were induced by the 1718 Tongwei earthquake rather than the 1920 Haiyuan earthquake. The verification of the seismic information in historical records can effectively avoid exaggerating or underestimating the damage of seismic events. Xu Yueren et al. (2020) detailed the 1718 Tongwei *M*7½ earthquake through field surveys, document sorting, and manual visual interpretation of UAV images, suggesting that the disappearance of ancient Yongning town was not directly related to the earthquake-induced landslides. They note that the statement of "Yongning Town is entirely buried by the earthquake" in the historical records describes the phenomenon that loess dust has pervaded the entire Weihe Valley, and argued that these earthquake-induced landslides may be the reason for burial of the residential areas on valley-side slopes, while the failures at those locations inside the valley were associated with the amplification effect of ground shaking.

Quantitative research on the formation of landslides and dammed lakes from major historical earthquakes is of importance for further understanding of the vibration characteristics and surface processes of earthquakes. Du Peng et al. (2020) used UAV photogrammetry and the morphology recovery method to calculate the volume of the Qiuzigou dammed lake sediment and landslides induced by a historical earthquake, yielding landslide volumes of $235 \times 10^4\ m^3$ and $229 \times 10^4\ m^3$, on the opposite slopes, respectively, while the volume of related dammed sediment is $573 \times 10^4\ m^3$. They also found that the age of the bottom of the sediment in this lake is 2890 ± 30 BP, which coincides with the 780 BC Qishan earthquake. Zhang Yanbo et al. (2020) selected rock falls and loess landslides triggered by the 1556 AD Huaxian *M*8½ earthquake to calculate their sizes by using UAV photogrammetry. The results showed that the Huangjiagou rock fall has an area of $3.03 \times 10^5\ m^2$ and volume of $0.699 \times 10^6\ m^3$, indicating a rock fall with large impact range but limited collapsed material, while the three loess landslides have volumes of $0.283 \times 10^8\ m^3$, $0.074 \times 10^8\ m^3$, and $0.377 \times 10^8\ m^3$, respectively, which are the key reason for serious local toll.

Considering the existence of numerous shallow-buried tunnels traversing high slopes in the loess plateau is very important for the public safety. Sun Wen et al. (2020) analyzed the characteristics and process of the destabilization of tunnels and slopes, and proposed valuable suggestions regarding the reinforcement parts of a tunnel for reducing seismic damage. Their analysis showed that the main seismic damage on a slope includes the failure of the sliding surface between the top and foot and the stripping of the soil around the tunnel entrance, while the damage on a tunnel is mainly manifested as the seismic-induced subsidence at the portal section and the cracking deformation at joint areas. They proposed that the "staggered peak distribution" phenomenon of the maximum acceleration values at the vault and inverted arch area can be considered as a criterion indicating that the tunnel reaches the threshold of dynamic failure. Li Peng et al. (2020) selected a double-sided loess slope as the research object to test vibration response law and frequency spectrum characteristics of the slope. They found that the dynamic response of the double-sided loess slope increases as the vehicle load increases, and the area of strong vibration response is located in the middle of the side slope. When the vehicle load is small, the vibration wave amplification effect is obvious, also indicating that the spectrum distribution of the *X*-direction wave is of a single-peak shape, and the dominant frequency is concentrated in 30-50 Hz, and the frequency spectrum distribution of the *Z*-direction wave shows a multi-peak shape, and the dominant frequency is concentrated in 20-180 Hz. Ma Xingyu et al. (2020) selected the Shibeiyuan Landslide in Guyuan as a case study to examine the characteristics of dynamic strain, dynamic stress and pore water pressure. Their work found that the fluidity of liquefied loess changes from shear thickening to shear thinning as the shear force continues, the fluidity of liquefied loess is closely related to its structure, the apparent viscosity and deviant stress change with axial strain in a similar manner. They also estimated the slip distance based on sample tests, in good agreement with the field investigation.

In addition, Zhang Yu et al. (2020) argued that the rainfall is one of the most common factors leading to loess slope instability (landsliding). They used software Geo-studio to analyzes the slope soil parameters and slope stability under five types of rainfall conditions and found that the fitting between rainfall intensity and safety factor on the upper slope is excellent, the residual points are evenly distributed in a belt of $\pm$ 0.1, and the data basically conform to the nonlinear sine model, indicating that the curve plays an essential role in slope health diagnosis. SBAS-InSAR technology can reduce the influence of terrain-simulation error, time-space decorrelation, atmospheric error, and improve the reliability of surface-deformation monitoring. Yu Haihua et al. (2020) focused on the Jiangdingya landslide area in Gansu Province. They analyzed 84 scene ascending-orbit Sentinel-1A SAR images from 2015 to 2019 and found that the early landslide identification method based on SBAS-InSAR technology is highly feasible for large areas with potential landslide hazard.

Nine articles are included in the issue, which show some latest research progresses on the earthquake-triggered landslides in loess areas and stability of loess slopes under dynamic loadings. We would like to thank Prof. Wang Baoshan, a deputy editor-in-chief of *Earthquake Research in China* for his supports in organizing this special issue and assistance during the review, modification, and verification process. We are also grateful to all the authors for their submissions to this special issue, to all the reviewers for their valuable comments and suggestions to the submitted manuscripts.

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