

1739年M8中国銀川平羅地震による万里の長城のずれの再評価 Reevaluation of the offset of the Great Wall caused by the ca. M 8.0 Pingluo earthquake of 1739, Yinchuan graben, China

林 愛明^{1*}, Rao Gang¹, 公 王兵², 胡 建民²
Aiming Lin^{1*}, Gang Rao¹, Wangbin Gong², Jianmin Hu²

¹ 京都大学大学院地球惑星科学専攻地球物理学教室, ² 中国地質科学院地質力学研究所

¹Department of Geophysics, Graduate School of Science, Kyoto Univ., ²Institute of Geomechanics, Chinese Academy of Geological Sciences, China

1739年M8中国平羅地震に伴い、明の時代に造られた銀川盆地の北西側に位置する万里の長城に最大約3メートルの右横ずれが生じたことが報告された。しかし、我々の最近現地調査の結果、万里の長城が活断層崖の上に造られたもので、1739年平羅地震の際に変位されていなかったことが明らかになった。本講演では、現地調査の結果を報告するとともに、1739年M8平羅地震の震源断層について議論する。

The study of large-magnitude earthquakes that occurred prior to the availability of routine instrumental measurements relies mainly on the analysis of historical documents and field observations. Significant uncertainties often exist in relation to the location of the epicenter, the magnitude, and the actual extent of damage, including the number of fatalities, caused by individual historical earthquakes, because records generally focused on the effects in the restricted regions that were settled. Field observations of the geologic effects of large historical earthquakes provide direct evidence of the coseismic ground deformation and seismic intensity of these large-magnitude events, and can therefore help to improve our understanding of the dynamic mechanisms associated with seismic faulting, and our ability to assess seismic hazards in densely populated epicentral regions.

China is located in one of the most active seismic regions of the world and has experienced numerous destructive earthquakes over its long history. The damage caused by previous large-magnitude earthquakes has been recorded in historical documents, and coseismic ground deformation is locally preserved in ruined ancient buildings such as temples, tombs, and other constructions erected over the past several thousand years (EBASP, 1998; People Network, 2012). Therefore, the ruins of ancient civilizations can sometimes be used to indicate the nature and extent of ground deformation and damage caused by large-magnitude earthquakes.

Previous studies have shown that the Great Wall of China was damaged and offset by the ca. M 8 Pingluo earthquake of 1739 along an active fault zone in the Yinchuan graben, on the western margin of the Ordos Block in northern central China. Based on the apparent displacement, it was concluded that the Great Wall was right laterally offset by 1.45-1.95 m, with a 0.9-2.0 m vertical component, at three locations in this area (He, 1982; Liao and Pan, 1982; Zhang et al., 1986); consequently, the maximum cumulative displacement of the wall was calculated to be 3 m dextral and 2.7 m vertical (Zhang et al., 1986).

However, our recent fieldwork has shown that the Great Wall was probably not affected by the ca. M 8 Pingluo earthquake of 1739, as reported previously. In this study, we reinterpret the offset of the Great Wall on the basis of our new field observations, and attempts to identify the source seismogenic fault that triggered the 1739 M 8 Pingluo earthquake. Our field investigations reveal that (i) the Great Wall was not offset by the ca. M 8 earthquake of 1739, but the wall was, in fact, built on the pre-existing fault scarps; (ii) the Yinchuan-Pingluo fault was most probably the source seismogenic fault of the 1739 earthquake. More work is required if we are to better understand the deformation characteristics of the source seismogenic fault, and also improve our ongoing assessments of the seismic hazard within the densely populated area of the Yinchuan graben.

キーワード: 1739年M8中国銀川平羅地震, 万里の長城, 地表地震断層, 活断層, 変位, 古地震

Keywords: 1739M 8.0 Pingluo (China) earthquake, Great Wall, coseismic surface rupture, active fault, displacement, paleoearthquake