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Study on Early Recognition of Loess Landslides Based on Field Investigation

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Abstract: For the purpose of agriculture irrigation, river water has been introduced into Heifangtai region from the Yellow River several times a year since 1968, which ensued a steady rise in underground water level by a yearly rate of 0.18 m with a cumulative total rise of up to 20 m over Heifangtai catchment. This ponding effect of water injection triggered landslides (3~5 events per year) at the edge of Heifangtai tableland. Failures of loess slopes have caused high causalities, and inhibited the local economy. This study aims at investigating the distribution patterns of loess landslides and their formation conditions in Heifangtai region, so as to establish approaches to early recognition and prediction of underlying landslides. Landslides in Heifangtai were delineated through visual interpretation of high resolution images obtained by unmanned aerial vehicle photogrammetry. Digital Elevation Model with high resolution 10 cm was acquired by 3D laser scanning technology and close-range photogrammetry. With field investigation, landslide distribution patterns and characteristics, as well as the local geological structure, were examined and two early recognition criteria for landslides are established. The results indicate that an intact slope section between two old landslide sections is the most possible locations for new landslides and areas with rising groundwater level are prone to landslides. For example, in 2015 a landslide occurred at the gaps of a 2014 landslide body. The rising of local groundwater level was induced either by blockage of underground water outlets by landslide deposits and freeze in winter or by heavy rainfall. Early recognition of loess landslides would protect local communities and land resources from landslide hazards.

Keywords: loess landslide, early recognition, landslide potential, rising underground water level, static liquefaction, field investigation

1 Introduction

Loess covers about 10% of the Earth's land surface. It is mainly concentrated in the northern hemisphere temperate zones, semi-arid zones, and the leading edges of deserts (Derbyshire et al 1998, Derbyshire et al 1991, Liu 1985, Pecsi 1990). Many large-scale loess landslides occurred in these areas were reported (Derbyshire and Mellors 1988, Sun 1988, Ishihara et al 1990, Rogers et al 1994, Jefferson et al 2003). The Chinese Loess Plateau with 317,000 km^2 constitutes is the largest bulk accumulation of loess on earth (Liu 1985). The Loess Plateau is mainly distributed in four provinces, Shanxi, Shaanxi, Gansu and Ningxia. Loess thickness generally exceeds 100 m over large areas in the Loess Plateau. The maximum thickness is up to 500 m, measured at a site near Jingyuan County in eastern Gansu (Liu 1985). Catastrophic mass movements with loess origin are recurrent over loess deposit areas (Derbyshire 2001), posing a serious threat to public safety, infrastructures and farmlands (Lin and Liang 1982, Sun 1988,

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